

Fabbrica della Conoscenza

XIII Forum Internazionale di Studi

Le **Vie** dei
Mercanti

Carmine Gambardella



HERITAGE and TECHNOLOGY

Mind Knowledge Experience

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Le Vie dei Mercanti
XIII Forum Internazionale di Studi

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Via Monte di Dio, 54
80132 Napoli
Telefono e fax +39 081 7646814
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Based on blind peer review, abstracts has been accepted, conditionally accepted, or rejected.

Authors of accepted and conditionally accepted papers has been invited to submit full papers. These has been again peer-reviewed and selected for the oral session and publication, or only for the publication in the conference proceedings.

Conference report

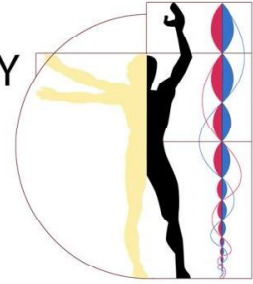
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Morphological Investigations and Virtual Reconstructions of the Domus of the Northeast Quarter of Volubilis (Morocco)

Concepcion RODRIGUEZ-MORENO¹, Jose Antonio FERNANDEZ-RUIZ²

⁽¹⁾ Architectural Graphic Expression Dpt., School of Architecture, University of Granada, Granada, Spain.

E-mail: conrodriguezmoreno@gmail.com

⁽²⁾ E-mail: jaf Ruiz@gmail.com

Abstract

Along the 1st and the 3rd centuries A. D. the city of Volubilis was developed as an important administrative and economic center. Proofs of its prosperity are the ruins of several splendid Domus that were built in the Northeast Quarter, on both sides of the Decumanus Maximus. These Domus were excavated and investigated in the sixties by the archaeologist Robert Étienne.

Fortunately, through the declaration of Volubilis as a World Heritage Site by UNESCO in 1997, its progressive spoliation has been paralyzed. Nevertheless, after Robert Étienne, no significant researches have taken place on these great residential architectures.

In recent years we worked on some of the best preserved Domus: House of Venus, House of the Labours of Hercules, House of Dionysus and The Four Seasons, House of Flavius Germanus, House of the Sundial, etc. We used them as sources for teaching about investigation and virtual reconstruction of the Architectural Heritage in our School of Architecture.

Several reconstructive hypotheses of these houses have been carried on the basis of texts of Vitruvio and Pliny, Ancient Roman architectural examples, planimetric surveys made by Robert Étienne and some own graphic material gathered in situ. We built virtual models with unwrapping textures and we achieved to merge them in its real environment by using Camera Match techniques. Our final goal was to recover some sort of the perception and the emotional reaction that those disappeared architectonic spaces could arouse in their former inhabitants.

Keywords: Volubilis, Romano-African Domus, Virtual Reconstruction, H-BIM categories

1. The archaeological site of Volubilis and its Northeast Quarter

Located in a fertile agricultural area on the foothills of the Jebel Zerhoun, 30 km from Meknes, the ancient city of Volubilis was founded in the 3rd century B. C. under the Carthaginian influence [1]. In the 2nd century B. C. it became part of the tribal Berber kingdom of Mauretania which was joined to the Roman Empire in 40 A. D. For two centuries, Volubilis was an important administrative and economic nucleus of the imperial province of Mauretania Tingitana and the city experienced its golden age: a new urban pattern was developed, widening the already existing one; the Aqueduct was constructed to supply Baths, public fountains and some private residences; the monumental center began to take shape with buildings and spaces as the Judiciary Basilica, the Forum, the Capitolium or the Triumphal Arch; a new luxurious residential quarter, made up of magnificent Domus, was erected in the Northeast area [2].

Unfortunately the city was soon left on its own fate, when Roman authorities and Army were all transferred in 285 A. D. An earthquake in the 4th century is believed to have caused extensive damage in a still inhabited city but from the 7th century and during the period of Arab rule, it was converted into an open quarry for the new buildings of Meknes. Its name and its history were forgotten.

It was not until the late 19th century when the ruins of Volubilis were identified by Charles Tissot [3]. Excavation at Volubilis was opened in 1915 by Hubert Lyautey, governor-general of the French protectorate of Morocco. It was carried on with German prisoners of war as workmen and it was focused on the Basilica and the Triumphal Arch areas [4]. In subsequent years (1917-1919), the archaeological ruins of the Forum and several nearby Domus were rediscovered, making clear the existence of a whole buried city.

Almost one hundred years later, after more than 2.000 excavations made by numerous institutions, only the third part of Volubilis has been cleared. One of the most studied areas is the Northeast Quarter, which is split in two by a twelve meters wide Decumanus Maximus. On both sides of it, twenty-three houses with columned courtyards and elaborate mosaics were excavated and well documented by the archaeologist Robert Etienne in the early sixties [5]. After that, no more significant researches have been made; neither reconstructive hypothesis has been published.

Since the ruins of these magnificent Domus present an important level of authenticity and integrity we decided to face the morphological investigation and the virtual reconstruction of some of the best conserved ones: the House of the Labours of Hercules, the House of Flavius Germanus, the House of Dionysus and the Four Seasons, the House of the Wild Beast, the House West of the Palace of Gordian, the House of the Two Presses, the House of the Sundial and the House of Venus.

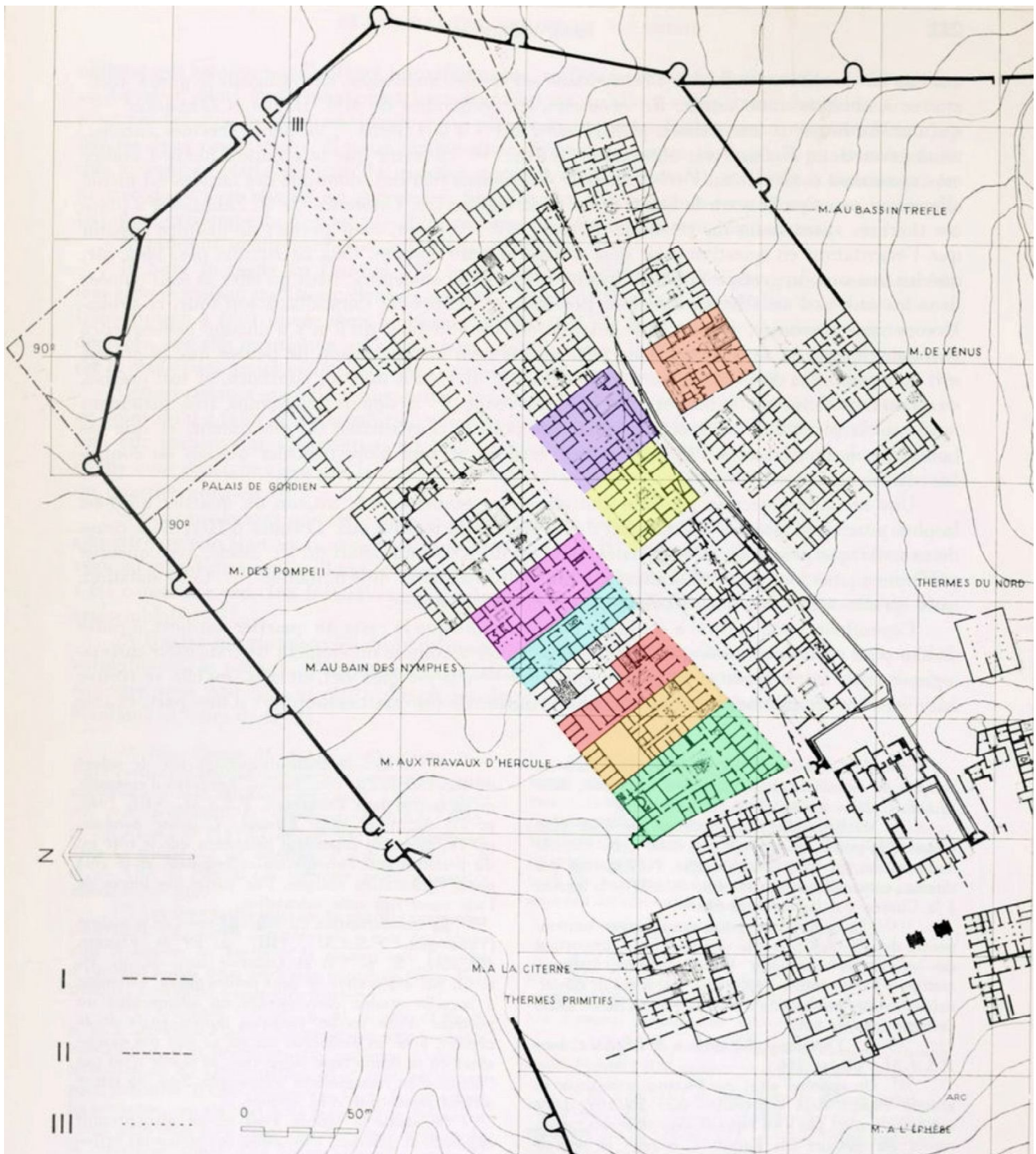


Fig. 1: The Northeast Quarter of Volubilis. The analyzed Domus appear highlighted in color. (Based on Rebuffat, 1965)[6]

2. Methodology

Our investigation was initiated with the deep study of the documental and bibliographical sources concerning past and contemporary analogous architectures. We collected plans and information about the Romano-African Domus in general [7] [8] [9] and the Domus of the Northeast Quarter of Volubilis in particular [10] [11]. Later, we move up to the archaeological site with the aim of make a complete survey of the preserved remains by photogrammetric techniques and direct measurement procedures. From these previous data and on the basis of functional and constructive criteria, we began to make some morphological hypotheses of the eight selected Domus.

In order to address the subsequent process of virtual recreation, we developed a technical document that should differentiate diverse types of 3D elements. Our goal was to raise the basic categories of objects that could organize any H-BIM model, whether the represented is real or digitally reconstructed:

Category 1: Archaeological Remains

Category 2: Physical Anastylosis

Category 3: Digital Anastylosis

Category 4: Virtual Representation of Physical Evidences

Category 5: Virtual Representation of Documentary Evidences

Category 6: Virtual Representation by Physical Analogy

Category 7: Virtual Representation by Documentary Analogy

The first two categories correspond to well-positioned pieces and elements, which can be documented *in situ*.

The “Digital Anastylosis” category is referred to objects that exist in the physical world but do not occupy their original position, so they are digitally repositioned. An example would be the capital that belonged to one of the columns of the Peristyle but now lies on the ground.

From the fourth category onwards, the objects completely pertain to a virtual sphere. None of the elements of these categories exists *in situ*. A case of “Virtual Representation of Physical Evidences” could be the digitally-modeled columns which are used to make the virtual completion of a portico where only an entire column and the base of the other ones are conserved.

In the fifth level of uncertainty, we would find the category of digitally-modeled elements which are created from historical graphic and textual documents (pictures, plates, literary descriptions, etc.). It is important to note that these documentary evidences have different levels of reliability, so the definition of some sub-categories could be possible.

The last two categories, “Virtual Representation by Physical Analogy” and “Virtual Representation by Documentary Analogy” are undoubtedly the most uncertain ones but the total completion of the virtual reconstruction model would not be possible without them. The objects that belong to these groups are digitally-modeled from analogous contemporary architectures which are preserved elsewhere, or from the historical documents that describe those architectures. In our specific case for example, the writings of Vitruvius were particularly important to produce objects of the seventh category.

Once the research work and the virtual reconstructions were completed, we thought it would be interesting to lead our graphic results towards an emotional way. There are two reasons for this:

The first of them is that we believe that survey plans and scientific reports will hardly captivate receivers who are not knowledgeable or not interested about these issues. Therefore, we try to look to the general public, who should be the final beneficiary of all our investigations.

The second and main reason is that we are architects and we have some specific objectives. In the field of the Virtual Reconstructions, each specialist pursues his own goal, depending on his educational background. Our specific goal could be summarized as “recovering the perception of a disappeared architectonic space with the final aim of provoking an emotional reaction that could be similar to what the former inhabitants of this space would experience”.

This is a very sensitive issue because there is always the risk of the research could be considered fictional, gratuitous or even unscientific. It is not our case. We have founded all our decisions on the basis of a firm support and all the hypotheses and levels of uncertainty have been documented. We cannot expect that the resulting images offer a faithful reproduction of what existed: this is not possible. However, we can accept that, for example, a disappeared capital can be digitally replaced by other similar. The perception of the architectural space will not change. Another example could be the *frescos* that would decorate the walls of these houses. In 1960, Robert Etienne described the remains of a pictorial decoration, preserved in the walls of the House of the Wild Beasts and forty-five years later, we can still see some of them. With this in mind, we allowed ourselves to recreate *frescos*, with similar geometry and colors, in other Volubilitan Domus. Although we know this is not correct from the archaeological point of view, thanks to the Virtual Representation by Physical Analogy, we could at least get closer to the emotional impression that the architectural space would communicate in its early days.



Fig. 2: Remains of pictorial decoration in the House of the Wild Beast of Volubilis. On the left, as they were documented by Robert Etienne in 1960. On the right, as they are preserved today.

3. Results

3.1 Morphological Scheme of the Volubilitan Domus

After our analysis we can conclude that the typical Volubilitan Domus usually have an extremely wide rectangular plan, sometimes extending over more than 1500 m². They use to have several entrances, but the main one is distinguished from the others because it is composed by a large door flanked by pilasters and a small door. The first one was opened on special occasions and it was designed for the passage of *lecticae*. The second one was the common door for pedestrian use.

The *Vestibulum* is one of the largest rooms. It is usually paved with large stones and includes a room for the doorkeeper. It would serve as a transitional space to a central courtyard. In contrast to Italic Roman houses, there is no *Atrium* in the Domus of Volubilis. There is a broad *Peristilum* that often occupies more than 300 m² and which is always surrounded by porticoes supported on columns. A pool is located in the center of its open-air portion. It is supplied by water from the city aqueduct so it cannot be seen as a typical roman *Impluvium*.

Two different reception rooms are normally located around the *Peristilum*: the *Triclinum* and the *Oecus*. The *Triclinum* is a luxurious dining room with squared proportions. It usually has a three-bay entrance and a U-shaped floor mosaic. The *Oecus*, also called *Exedra* or *Tablinum* by some authors, would be the most important reception room in the house where the patron would receive his clients during the *Salutatio*. The *Triclinum* and the *Oecus* are usually placed in orthogonal positions: so if the *Oecus* has a northern location, the *Triclinum* will have an eastern or western one. Most of the times the *Vestibulum*, the *Peristilum* and the *Oecus* are aligned, but some Domus have a bent entrance to preserve intimacy so they do not follow this axial design.

The preservation of some stair steps and the use of stone reinforcements in certain walls suggest that, in some cases, the houses could have had a second floor. The conserved vestiges do not allow us to be accurate, but we have raised some hypotheses based on the constructive and functional logic. In respect to the covering system, a sloping tile roof or a flat roof could have been used since remains of both solutions have been found in the archaeological site.

In addition to the *Peristilum*, a secondary courtyard called *Atrium* usually exists. It is smaller, normally framed by four columns. It ensures access to natural light and ventilation for the private apartments that are distributed around it. The apartments are often heated by hypocausts that would keep rooms warm in winter. Because the rich owners of these Domus used to engage in the exploitation of wheat and oil, most of the times an industrial area –with oil presses, mills, grain warehouses, ovens, etc- appears as a part of the Domus. This industrial area uses to be completely isolated from the residential area and has a separate entrance from a side or a back street.

Some of the products made in the industrial area would be sold in small shops, called *tabernae*, which also belong to the Domus. They are usually located in the façade area, on either side of the main entrance of the house. Probably some of the *tabernae* would be rented by other merchants, thereby increasing the benefits of who owns the whole Domus.

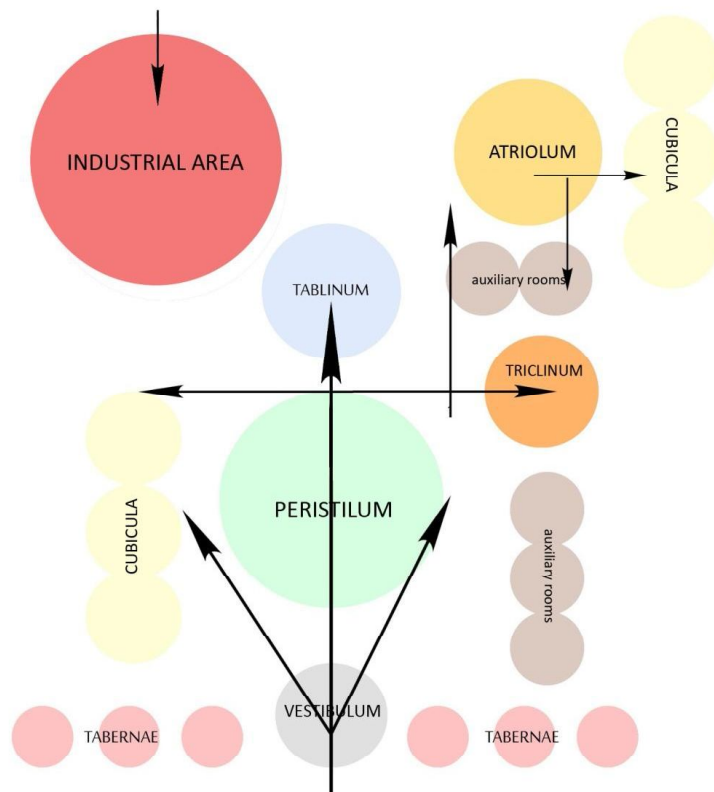


Fig. 3: Morphological scheme of the typical Volubilitan Domus.

Therefore, the Volubilitan Domus seems to have four different functional areas: a public residential area which is organized around the *Peristilum*, a private residential area around the *Atrioium*, an independent industrial area and a commercial area in the zone of the façade.

3.2 Individual cases: Virtual reconstructions

Due to the limited length of this paper, although eight Domus were digitally reconstructed we will only expose the results concerning three of them: the House of Dionysos and the Four Seasons, the House of Venus and the House of Flavius Germanus.

3.2.1 House of Dionysos and the Four Seasons [12] [13]

Brief morphological description:

This Domus seems to have three different historical stages. The main entrance is composed by one-bay door. The *Vestibulum* changed its central position to a lateral position over the years, so it lost its alignment with the *Peristilum*. The rectangular *Peristilum* was supported on ten Corinthian columns. Twin *Oeci* to the North. *Triclinum* to the East. Commercial area on the façade: four *Tabernae* with entrances from the *Decumanus Maximus*. No *Atrioium*. Complete mosaic floor in the *Triclinum*. The industrial area has an independent entry for carts from the back *Decumanus*. It would be composed by grain warehouses and four more *Tabernae*. One of them might have been a bakery.

HBIM-object categories (general position):

- Category 1: *Decumanus Maximus* portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Oeci*, *Tabernae*, Industrial Area
- Category 2: walls, *Peristilum*, *Triclinum*,
- Category 3: walls, *Peristilum*, *Triclinum*, *Oeci*, *Tabernae*, Industrial Area
- Category 4: *Decumanus Maximus* portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Oeci*, *Tabernae*, Industrial Area
- Category 5: *Peristilum*, *Triclinum*, Mural Paintings, Industrial Area
- Category 6: *Decumanus Maximus* portico, main entrance, walls, *Triclinum*, *Oeci*, Mural Paintings, *Tabernae*
- Category 7: Main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Oeci*, *Tabernae*, Industrial Area, Roofs, Other Architectural Spaces

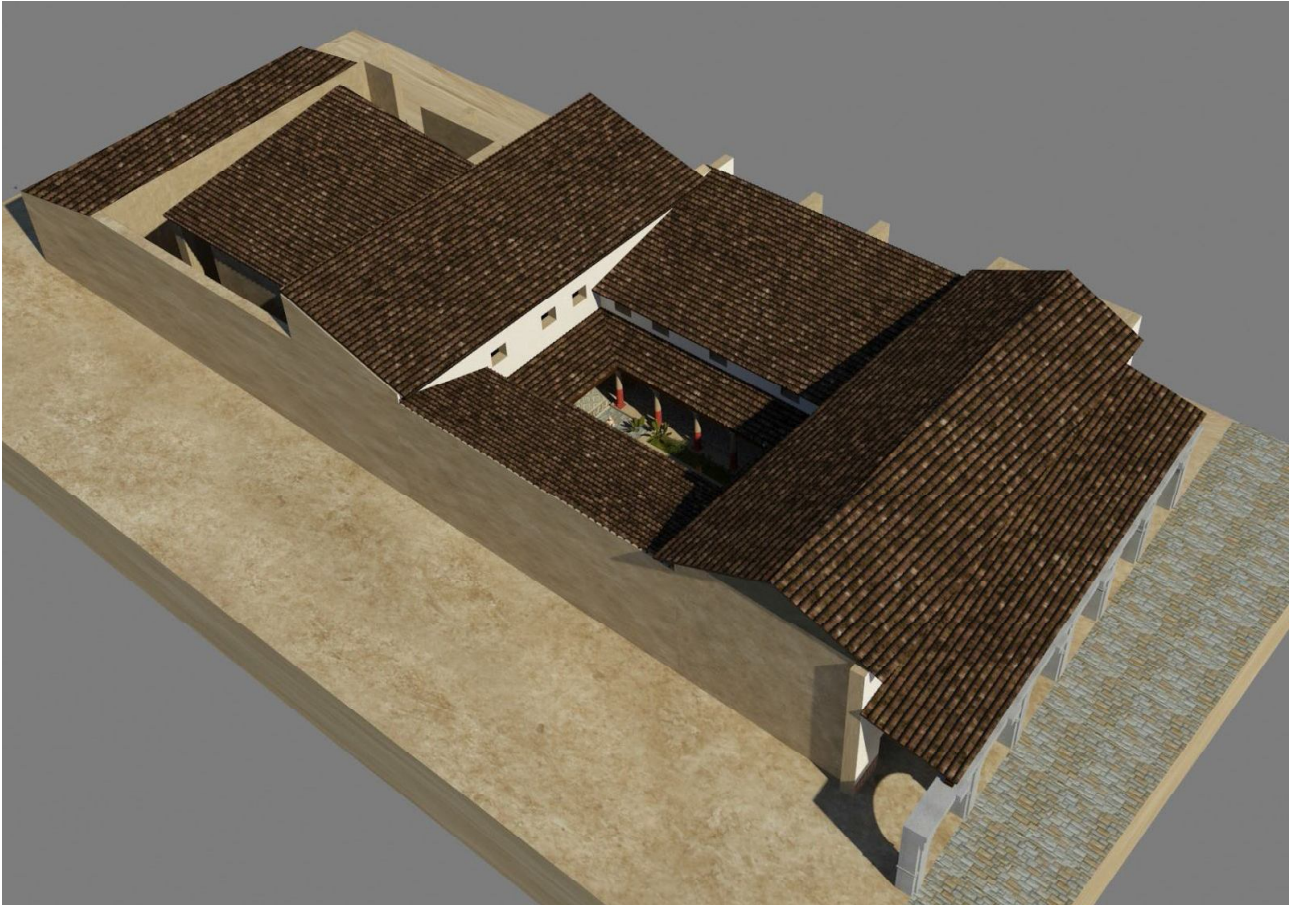


Fig. 4: House of Dionysus and the Four Seasons: General view of the Virtual Reconstruction (3rd Stage), courtesy of S. Bustos.



Fig. 5: House of Dionysus and the Four Seasons: Virtual Reconstruction of the Peristilium, courtesy of H. Qamhiyeh.

3.2.2 House of Venus [14]

Brief morphological description:

This house seems to have two different historical stages. In the last of them, the entrance portico was walled and annexed to the inner space of the house. The main entrance is composed by a large door and a small door. The *Vestibulum* is nearly in line with the luxurious *Peristilum* and *Oecus*. The *Peristilum* is almost squared and it was built on eight sandstone columns with truncated pyramid-shaped capitals. The pool is double T-shaped. *Oecus* to the South, *Triclinum* to the West. The *Atrium* with a lobed pool and the private apartments around it are located to the South-West. Mosaic floors preserved in eight rooms (including *Oecus*, *Triclinum* and Private Apartments) and seven corridors. No industrial area. This house has private *Termae*. It probably also had a second floor as we can infer from the stone reinforcements that are preserved inside the walls of the North-East area.

HBIM-object categories (general position):

- Category 1: main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Atrium*, *Cubicula*, *Termae*
- Category 2: main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Atrium*, *Cubicula*, *Termae*
- Category 3: walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Oecus*, *Atrium*, *Termae*
- Category 4: entrance portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Oecus*, *Triclinum*, *Atrium*, *Cubicula*, *Termae*
- Category 5: *Peristilum*, *Oecus*, *Termae*
- Category 6: entrance portico, main entrance, walls, *Peristilum*, *Oecus*, *Termae*
- Category 7: Main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Oecus*, *Atrium*, Mural Paintings, Roofs, Other Architectural Spaces



Fig. 6: Domus of Venus: Front view of the Virtual Reconstruction (2nd Stage), courtesy of J. Perez.



Fig. 7: Domus of Venus: Longitudinal section of the Virtual Reconstruction (2nd Stage), courtesy of J. Perez.

3.2.3 House of Flavius Germanus [15] [16]

Brief morphological description:

The main access is located on the western corner of the house. It is composed by a large door and a small door. The wide *Vestibulum* has a room for the doorkeeper at the bottom. It produces a bent entrance to the *Peristilum* which was composed of fourteen Corinthian columns: five on the long sides and four on the short sides of the porticoes. The pool is small and it is not excavated in the ground. The main portion of this Peristilum was probably planted with herbaceous vegetation. *Oecus* to the North. *Triclinum* to the East. There are two commercial areas: four *Tabernae* with entrances from the *Decumanus Maximus* and five more *Tabernae* on the back side of the house. No *Atrium*. Complete mosaic floor in the *Triclinum* and two *Cubicula*. No industrial area. A wide *Hortus* would exist between the *Domus* and the secondary commercial area.

HBIM-object categories (general position):

- Category 1: *Decumanus Maximus* portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Oecus*, *Tabernae*
- Category 2: *Decumanus Maximus* portico, main entrance, walls, *Peristilum*, *Triclinum*, *Oecus*, *Tabernae*
- Category 3: *Decumanus Maximus* portico, main entrance, walls, *Peristilum*, *Triclinum*, *Oecus*, *Tabernae*,
- Category 4: *Decumanus Maximus* portico, main entrance, walls, *Vestibulum*, *Peristilum*, *Oecus*, *Tabernae*
- Category 5: *Peristilum*, *Triclinum*, *Oecus*
- Category 6: *Decumanus Maximus* portico, main entrance, walls, *Triclinum*, *Oecus*, Mural Paintings, *Tabernae*
- Category 7: Main entrance, walls, *Vestibulum*, *Peristilum*, *Triclinum*, *Oecus*, *Tabernae*, *Hortus*, Roofs, Other Architectural Spaces



Fig. 8: Domus of Flavius Germanus: Virtual Reconstruction of the façade, courtesy of L. Ciocarlan.



Fig. 9: Domus of Flavius Germanus: Actual view of the *Peristilum* and the same view in the Virtual Reconstruction, courtesy of R. Lopez-Toribio

4. Discussion: About emotional representations

Several years have passed since the 3D modeling appeared. Today, it can be considered a daily tool for the research of the Architectural Heritage, so the risk of generating virtual reconstructions based solely on the admiration to the digital techniques seems to have vanished. Now, we can concentrate on the authentic objectives of our scientific investigations.

As mentioned, the ultimate purpose of our research about the Domus of the North-East Quarter of Volubilis was to recover some sort of the perception and the emotional reaction that those disappeared architectonic spaces could arouse in their former inhabitants.

We are architects and we conceive Architecture, and by extension Architectural Heritage, as the material realization of an ideal form that arises as a result of a creative process that involves affective, cognitive, social, volitional, personal and spiritual factors. To fully assess or to know an architectural work, we have to visit it, we have to get the sensory experience of perceiving the articulation of the space, we have to see its scale and light, we have to feel its textures, we have to test its functionality, we have to verify its location in the landscape, etc. So we have tried to reconstruct the qualities of these experiences through the virtual recreation offered by a 3D computer model. It obviously does not substitute a direct observation of reality but we must admit that it recovers some of the spatial attributes that once would define the architectural essence of these Volubilitan Domus.

In addition, we think that the “emotional representations” make the Architectural Heritage more accessible to the general public. Survey plants and literary descriptions can hardly impress an ordinary user. People are not usually well versed in the historical, archaeological, architectonic or technical subjects that researchers habitually manage so they need a prior motivation that could encourage them to study these scientific documents. The observation of the images of the virtual reconstructions produces something magic and special into the spectator. These images reveal the mystery of what happened in the past and the viewer experiences a kind of excitement that could be compared with the feeling he perceives when he thinks about what will happen after death: Thinking about the past before we have born and thinking about the future after we have died, both belong to the same world.

The ruins of Volubilis symbolically connect us to the past of the city, but the digital images of the virtual reconstructions of those ruins connect us to the eyes of their former Roman inhabitants. Therefore, synthetic images have in some way the ability to immerse us in the Roman world.

In any case, we believe that this kind of “emotional” representations provides a wide and very valuable vision that substantially improves our knowledge and architectural comprehension of the Architectural Heritage. We consider that they could be used as a consistent method of analysis of many other historic buildings.

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