

3D Documentation for the Study of the UNESCO Site of Masada: Methodologies and Applied Research for the Analysis of Roman Fields

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The Masada Research Project – MRP – is a research project for the development of documentation methods of the archaeological area of Masada through digital technologies promoted by the "Landscape Survey & Design" laboratory of the University of Pavia and Florence, in collaboration with Department of Interior Building and Environment Design – Shenkar College of Israel with the participation of a researcher of University of Milan.

MRP saw numerous campaigns conducted on site by a multidisciplinary team to detect the entire plateau and surrounding Roman camps. The project defined experimental methodologies by combining and integrating different data acquisition techniques, for the construction of reliable 3D models useful for developing and managing cultural heritage.

The data collected, systematized into a digital archive formed a database of photos and drawings useful for digital and virtual reconstruction, which illustrates site conditions at the various evolutionary stages of Masada.

During the third documentation campaign (2015), were been measured buildings present on the plateau and some Roman camps, (the H camp and the F2 - "Silva Camp"). Thanks to an in- depth archaeological study it was possible to make some interesting proposals for architectural reconstruction of some military buildings, connected with the historical picture of the site.

Key words:

3D scanner, Photogrammetric Survey, Archaeology, Roman Camp, Roman Tent.

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INTRODUCTION

The research for the documentation of large archaeological complexes through digital survey is one of the main activities carried out within the architectural representation laboratories of the Department of Civil Engineering and Architecture of the University of Pavia.

The traditional representational discipline and its expressive aim, the drawing, still retain the role of communicative practice of excellence for the expression of morphological and constructive languages typical of the documentary and planning analysis of archaeological systems. However, they are characterized by a path of evolution, in particular instrumental, and of technological development of digital media and equipment that tends to replace their classical instruments of measurement and manual representation. This development is highlighted by two distinct points of view: primarily, the technological progress replaces the instruments of direct survey with a new generation of devices for the digitization of measured data; this is also followed by an evolution concerning the requested output data format. The development of virtual environments has generated a new class of representative works that are increasingly moving from real spatial constraints towards n-dimensional realities, where heterogeneous

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information contents are connected to representative graphic dimensions as integral parts of the documentation and analysis operations contained in a single virtual consultation system.

In this way, the drawing is conceptually placed towards technique and graphics as a fundamental tool of investigation and representative processing, founding a path of study on representation that through the centuries evolves between graphic solutions and methodological investigation towards objectives of academic, landscape, restoration and conservation fields. Research directions concern the geometric representation of architectural and environmental elements, initially limited to two-dimensional drawings for the production of updated metric documentative systems.

The digitalization of the heritage lends itself to establish paths of graphic representation that through the integration of databases and the development of virtual frontiers of the image can lead to a constant evolution towards three-dimensional systems for collecting, managing and querying the data.

The aim to transmit to the public the meaning of the signs that history has produced on a certain place constitutes one of the primary objectives of the evaluation processes envisaged for museum visits to archaeological sites. In this context, the architectural survey, especially by virtue of methodological developments related to digital acquisition and representation, is configured as the most appropriate discipline to generate virtual environments, reconstructions and three-dimensional models. These products, evolving in their implementable possibilities, promote the development of immersive systems or simply interactive systems where the user is able to interact with the archaeological site and its different types of information, confirming the function of drawing as semantic tool for the structuring of the information system and the configuration of complex databases. Through the digital survey and the use of specialized software, architectural ruins and anthropic remains, inside an archaeological area, can be made accessible to an increasingly aware and demanding public in a telematic and digital way through 3D virtual simulations.

3D databases are developed to generate surfaces and to build reliable models from discrete point cloud systems, basing on NURBS methodology and exploiting MESH reconstruction. Furthermore, databases are composed of numerous materials, multimedia-based, which provide information about the nature of the surveyed system, and where each media information is discretized to elaborate analysis models. The integration provided by the photographic data, for the generation of textures containing the superficial colorimetric information, is only one of the aspects concerning the production process of archaeological models. In general, the goal is to check the reliability and approximation of drawings for the development of reconstructions as faithfully as possible for the definition of a strategy to promote the site in its many forms.

Systems of migration of reality to virtual dimensions, with the realization of drawings that reproduce the real space and the structure of interactive relationships during the visit of the site, can open archaeological studies to new scenarios of enhancement for museum complexes such as Masada [Parrinello et al. 2016]. On the other side, these same contexts become fertile ground of experimentation for the development of information systems in which to bring out the story of human events through the drawing of a line (Fig. 1).

The development of critical models of analysis, based on virtual elements developed in three dimensions, configure 3D digital systems that give life to video games, 3D modeling, augmented reality applications and what is necessary for a different approach to representation, re-evaluating limits, aims and expressive potentials of archaeological assets. In this sense, the development of reliable drawings on elements as parts of a museum allow a reflection on the development of more participatory and environmentally conscious learning paths that can increase the interaction between user and information. In this context, the activities developed on Masada site aim to create opportunities to deepen the reading possibilities of digital databases on historical archeology. In particular, in this contribution the study of a Roman field documented through digital processes of survey is presented, and some thematic readings are highlighted in order to outline a multidisciplinary path that unites architects and archaeologists for the virtual reconstruction of the site [Parrinello 2017].

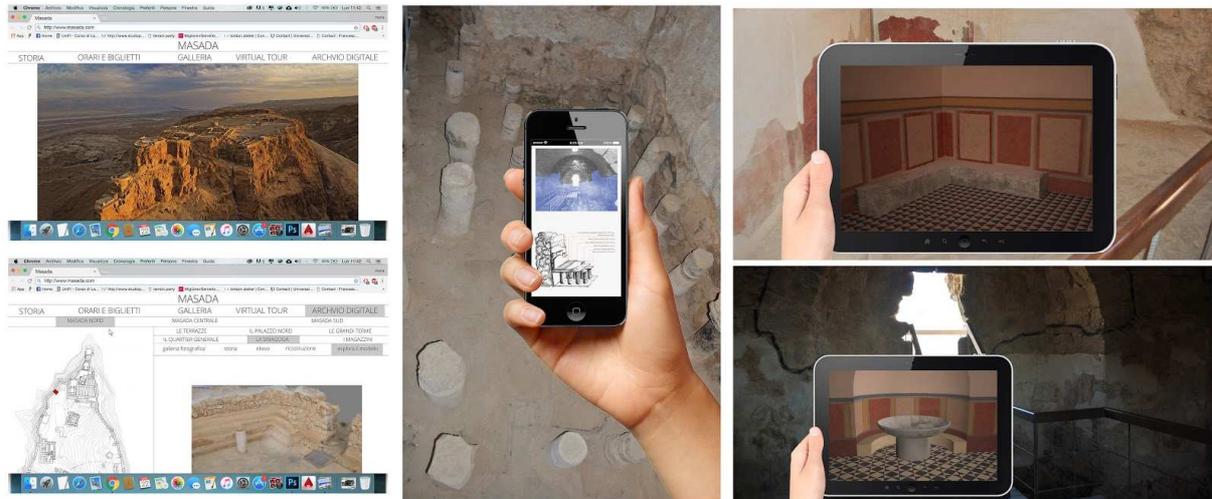


Fig. 1. Multimedia output - Some examples of implementation of the Masada museum through Augmented Reality tools produced for the creation of interactive systems.

The archaeological site, however, represents a built document where signs and symbols, as translation of construction systems and historical environments, in general, should be described together with the life that characterized the specific culture in which the specific heritage is located. The archaeological site is called to a new life, giving a meaning to the signs of history, and aimed at interpreting traces of the past to facilitate relationships and qualitative connections on information contents of databases.

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STUDY OF THE ARCHAEOLOGICAL SITE OF MASADA

The site of Masada (Fig. 2), discovered in 1828 by a traveler on the rugged mountains that rise on the east of the Dead Sea in the south-eastern Judea (Fig. 3), is nowadays part of the Israeli territory and about one hundred kilometers southeast from Jerusalem.

The site had been studied in 1933 by the famous expert Schulten [Schulten 1933; see also: Avi-Yonah et al. 1957; Yadin 1965; Yadin 1966; Vörös 2013], but only during the excavation activities carried out from 1963 to 1965 the great fortress was identified by the expedition led by the archaeologist Yigael Yadin.

Since 1966, Masada and its territory has become a protected area by the Ministry of Antiquities and starting from 1998 it was protected as National Parks, Nature Reserves, National Sites and Memorial Sites.

It became an UNESCO protected site in 2000 and today it is a wide archaeological park open to tourists, one of the most important in Israel, provided with a Visitors Centre and a funicular railway for a fast connection to the main site area, the fortress, which is located on the wide tableland on the top of the mountain. There is evidence in the form of archaeological ruins in a cave that there was a human settlement there in the Chalcolithic period (4th millennium BCE) and then in the Early Iron Age (10th -7th century BCE).

A big artificial underground cistern, together with numerous other basins for water reservoir, both on the top of the site and located on the steep slopes of the mountain, demonstrate the long-time human presence in the area. As many historians stated, among them Titus Flavius Josephus, the location had been used as a fortification from the second century BC, due to a rocky isolated mountain with only two access roads. On top of the hill, at a height of about four hundred meters above the Dead Sea depression, there is a flatland of an area of about ten hectares. This summit plateau is fenced by a curtain wall that extends for about 1,300 meters, and it is made of a double wall, with an outer curtain wall and reinforcement towers and with an interior wall, connected by transverse walls that form a series of communicating compartments (casemate system), once used as warehouses, arsenals as well as residences. Among these buildings there is also a synagogue (considered to be one of the most ancient in Palestine), and some buildings used as dovecote. Inside the fortified wall, in the northern area, there is a well-structured building complex: the

storehouses, made up of two series of buildings with long rooms (from 20 to 27 meters) and inner road network, the wide residences with inner courtyards, including the so-called Herod's Palace dating back to the first century BC. It is an amazing monumental complex located on three terraces of the rocky summit over the desert and with the beautiful panorama of the Dead Sea. Within the complex there is also a big watering place (the numerous rooms have been restored) opened on a courtyard with swimming pool and cisterns.

Another palace complex with various residences is situated in the south-western area of the fortified site and it consists of various rooms around courtyards with an unusual long entrance walls.

In the central part of the area there are the remains of a building from the Byzantine period, with a central plan, and so the settlement in the site is supposed to exist at least up to that period.

Well-preserved are also the ruins of the great structures for the siege of Masada, built by the Romans after the first Jewish war, consisting of a wall surrounding the hill, reinforced by towers and the presence of eight military camps.

Among the siege structures, the most impressive remain is the artificial ramp, made of earth and wooden structures (some traces still existing), used by Roman soldiers as sloping plane to reach the walls on the hilltop.

The good state of conservation of the entire complex including the fortress and the surrounding area (Fig. 4), also with the remains of the siege, made this area of great interest and proclaimed a World Heritage Site by UNESCO.

The main purpose of scholars dealing with wide archaeological sites and complexes, even in urban areas, like in Masada considered in its territorial context, is therefore to provide documentary evidences to every historic period shown by the archaeological stratification: no monuments, no activities and no periods can be considered more important than others, since the aim of its survey concerns the knowledge of the whole area in all its aspects. The analysis of the territory, both as a preliminary study with the aim of finding archaeological remains, and as a report of general statistical data about the history of the region, requires a high reliable morphological survey, conducted with 3D laser scanner at the architectural and territorial scale completed by traditional methods of research (Fig. 5). Referring to representation applied for archeological documentation, often technical drawings or surveys of excavation campaigns are used to integrate exhibition routes, developing scientific reports and narrative tools intended for sectoral experts, or in any case to a limited public.

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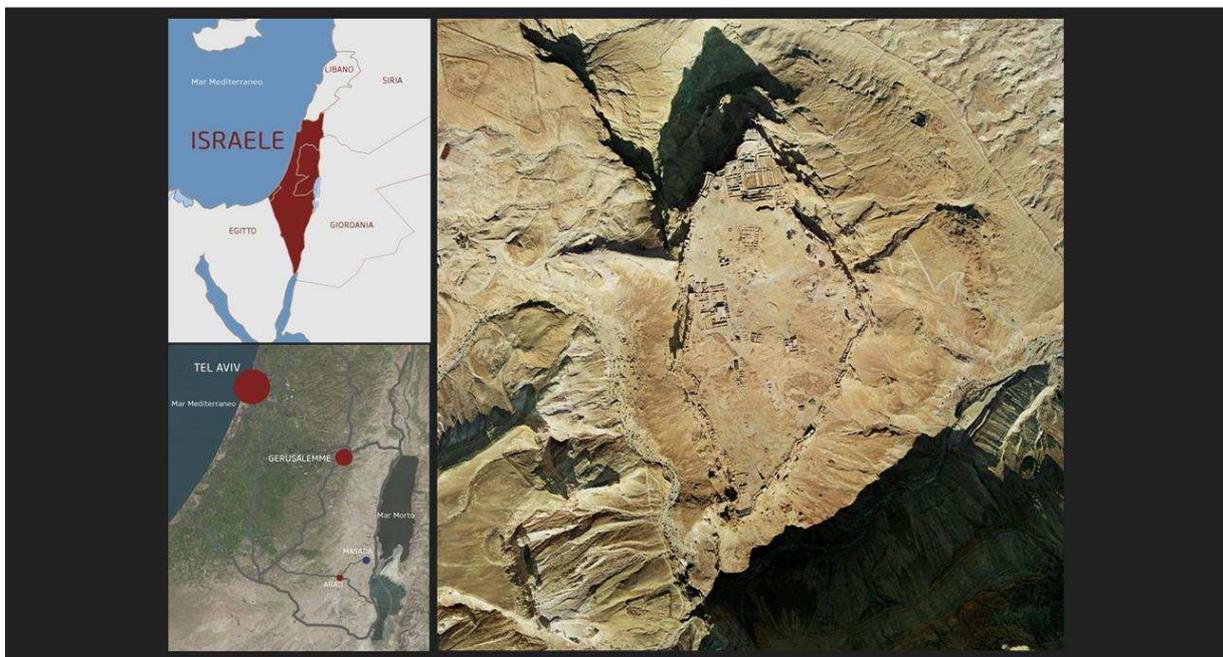


Fig. 2. Map and aerial imagery, geolocation of Masada and zenithal photo of the plateau. © MRP



Fig. 3. Hand Drawing. Directly to the south, along the valley of Wadi Araba: the saline in the depression of the Dead Sea. © MRP



Fig. 4. Hand Drawing. The slope of the mountain of Masada overlooking the valley. The contrast between the foreground, near, and the background of the scene, beyond the valley, are well defined; even if the tones of light does not help to define the depth. © MRP

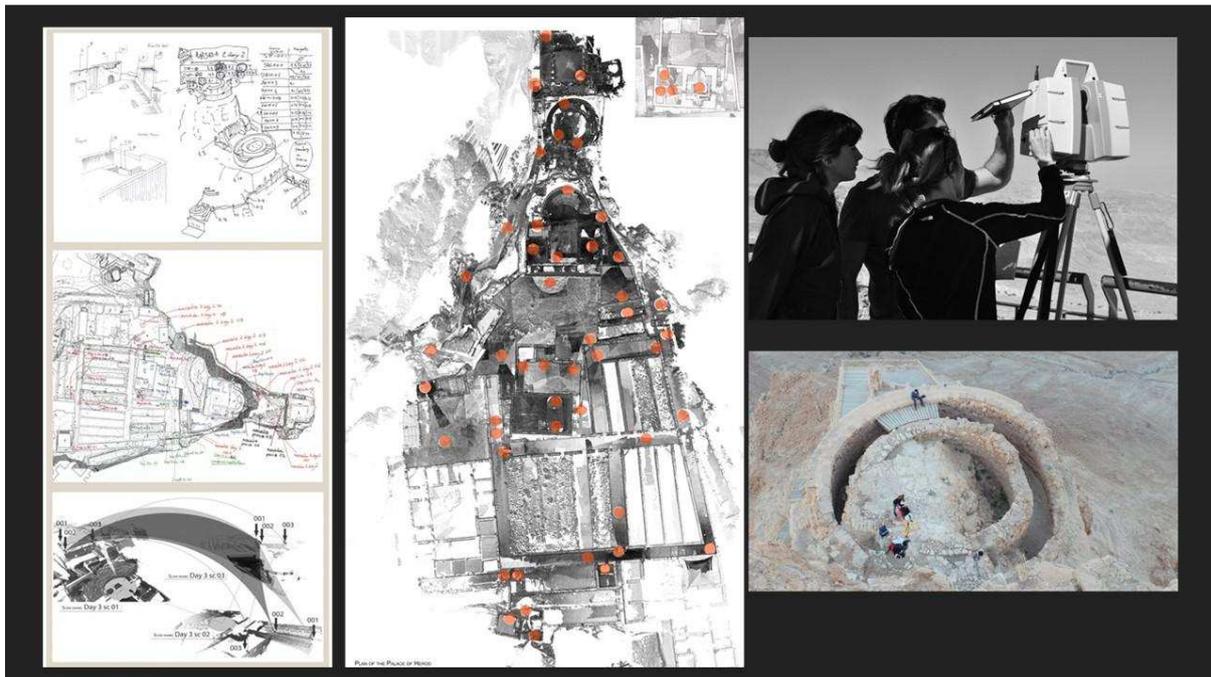


Fig. 5. Digital Layout. Some output of MRP: Laser scanning for the definition of the 3D metric database of the Northern Palace. © MRP

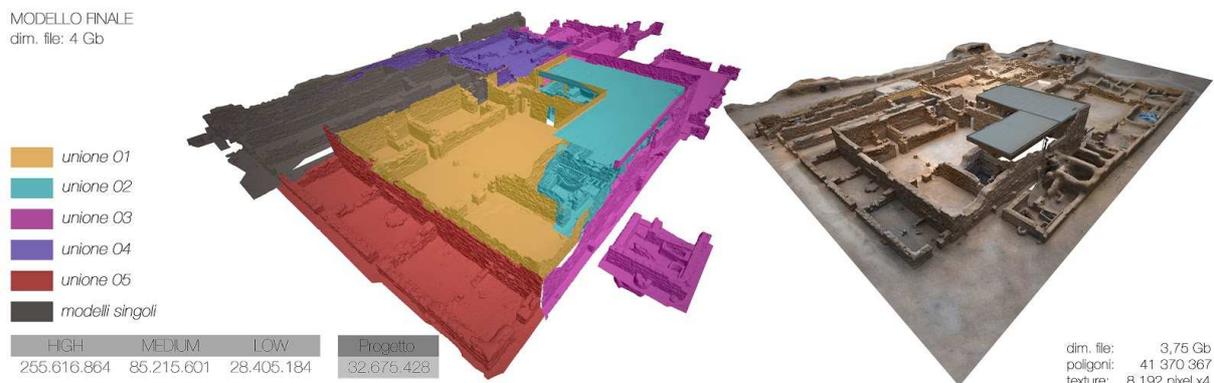


Fig. 6. Digital Layout. Production of the 3D model of the western building starting from photogrammetric models obtained by SfM acquisition. In particular the composition of the individual chunk for the control of the mesh and visualization of the finished model with the photorealistic texture. © MRP

THE MASADA SIEGE

The Masada plateau was occupied from the 2nd century BCE until the year 37 BCE (i.e. during the Hasmonean period) and it was fortified during the Period of Herod from 37 to 6 BCE (including the reigns of Herod the Great and Archelaus). This phase of fortification corresponds to the peak of the Augustan Age [Bar-Nathan 2006; Netzer 1991], which saw the building of a majestic villa that occupied the whole plateau. The complex was equipped with casemates, granaries, barracks and large, luxurious

private areas reserved to the royalty. To get an idea of the luxury, it's enough to think about the large pool in the southwestern part, the private thermal baths and the panoramic triclinium of the northern villa. After the Period of Herod, the villa was abandoned for about 70 years, known as the Time of Garrison I (6-66 CE), during which the hill was presided over by some Roman soldiers. No clear archaeological trace is left of it. During the first revolutionary uprisings that predated the 1st Jewish War, a rather large group of people took over Masada, killing the Roman garrison, and occupying the ruins of the Herodian villa with women and children for about a decade (66-74 CE), known as the Zealot Occupation.

During this time the various areas of the villa were reduced and repurposed, while the directions of travel and the access points to the common areas were changed.

This well-documented archaeological phase was followed by the Time of Garrison II (74?-115 CE). Following this time, the plateau was abandoned completely, only to be briefly seized again from the 5th to the 7th century CE, thanks to a short but intense monastic occupation in the Byzantine period.

Between the years 1995 and 2000 a team of archaeologists investigated the area to accurately date the Roman camps and the siege ramp [Stiebel and Magness 2007; Davies 2011], with the aim of dating the end of the Zealot occupation too.

At the end of the 1st Jewish War in 70 CE the last surviving rebels fled from Jerusalem and found shelter in the ruins of Herod's fortified villas that had been abandoned for almost 70 years.

The *Legio X Fratensis* systematically sieged the villas using war machines and harsh systems, including walls, towers and various fortifications that encircled the rebels' settlement (Fig. 7). The last one to succumb was Masada, which resistance ended dramatically between 73 and 74 CE.

At that time Masada was regarded as the most impregnable fortress. Built in the middle of the desert on top of a rocky range, surrounded by crevices and only accessible via two curvy paths, Masada was surrounded by a wall higher than 5 meters, 3 meters thick and equipped with thirty-seven towers higher than 20 meters.

The fortress had a limited amount of supplies available, thanks to the large storage tanks and to an efficient water collection system. The abundant supplies were carefully stored in the large warehouses located in the North.

Upon their arrival, the Sicarii found wheat, dates, legumes and oil still edible [Josephus VII, 296]. The plateau was left free of buildings to grow fruit trees, spices and vegetable gardens. All sorts of weapons were stored in the barracks constructed by the last Hasmonean king in prevision of military necessities.

With all that said, the only way to subdue Masada would have been a brutal attack.

The fortress was inhabited by about 960 people, many of which were women and children, guided by Eleazar ben Jair, descendant of Judas the Galilean. Governor Silva guided the whole *Legio X* against them, along with all the auxiliary forces scattered around the province, which were followed and supported by thousands of slaves as well as the free Jews forced to help the Romans with corvee labor.

The siege was carried out by employing the same tactics used a few months before to take over other Herodian fortresses, but this attack stood out for the extraordinary engineering abilities shown by the army.

The construction of the structures must have been very complicated, because of the lack of the raw materials such as wood and, most importantly, the drinkable water necessary to quench the thirst of a whole legion (about 13000 men)¹.

Silva, who had previously established some stock rooms in Hebron and in En-Gedi, sent the free Jews to transport everything that the army needed to Masada. Once the supply system was in place, the soldiers started fortifying the legionary camps as well as the offensive machinery.

On the eastern side of the mountain, tens of meters below the walls of Masada, Silva occupied a rocky platform that the natives called "White". He used it as a base to build a huge ramp called "siege terreplein", destined to fill the gap between itself and the defensive wall of the fortress.

¹ According to Yadin [1966, p. 223] the roman soldiers were 9000 in total; according to Roth [1995, p. 94] the troopers were 8000, plus 2000 slaves and 3000 Jewish laborers, adding up to 13000 men in total.

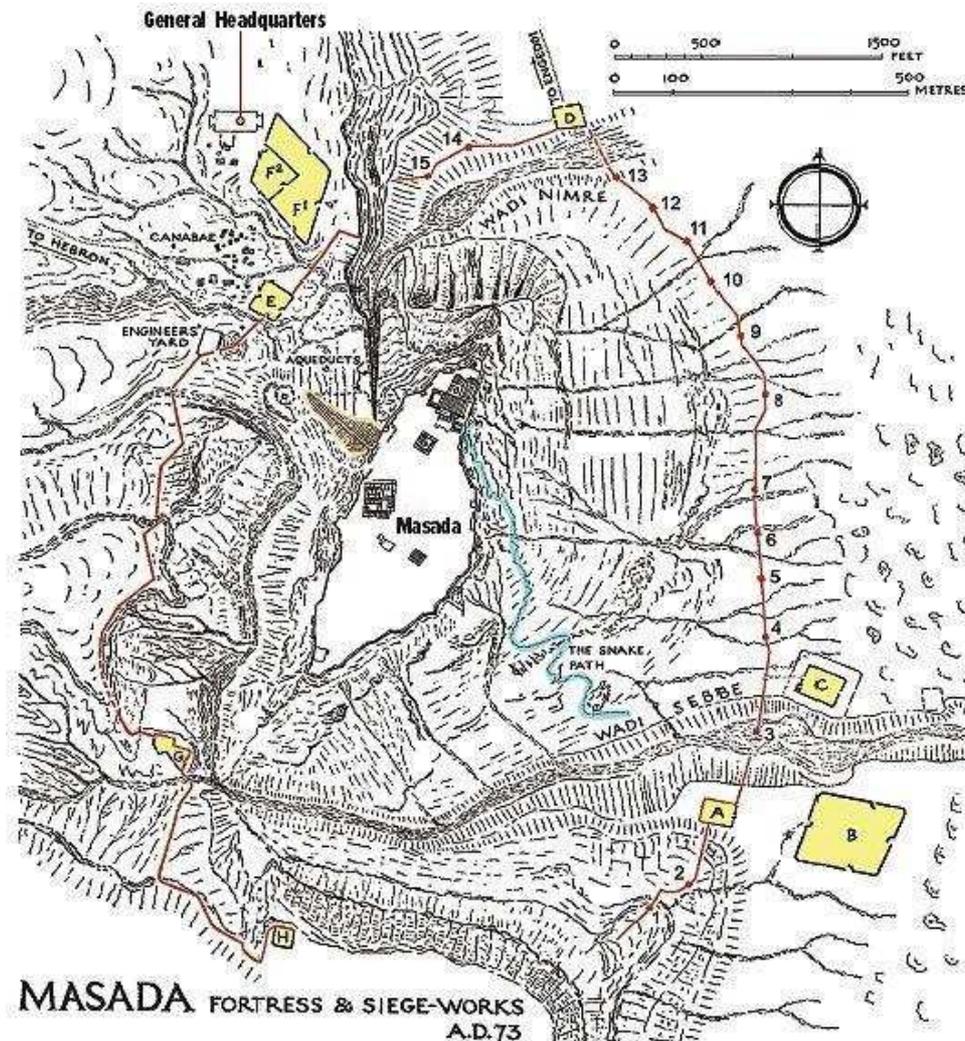


Fig. 7. Map. Siege structure around Masada. © [Richmond 1962, p.52]

The siege system included several military structures that ringed the Herodian residence, all connected to each other by a wall about 5 km long. On the flat northeastern area, the wall is studded with 15 square-sectioned lookout towers, located at 90 meters from each other. In the first map (Fig. 7) of the area sketched by Richmond [Richmond 1962, p. 52], the camps were organized alphabetically from A to H, starting from the southeastern camp next to the visitor's center and proceeding anticlockwise. The order of the turrets scattered around the vallum follows the same system. The Roman legions were quartered outside this defensive line in eight temporary encampments ("marching" forts). Strategically located away from crevices, wadi, and rocky sides, these camps guarded the various access points to fortress. At the end of the siege, two of these camps (F and C) were refurbished and employed again to house a semi-permanent garrison on the area.

The renovated camps needs fewer men, had restored walls and maybe elevated lookout points. This whole complex was created, coordinated and managed with the purpose of besieging Masada, which highlights a profound knowledge of the territory and a rather complex, preliminary strategic consideration. Camps A and C were located on the banks of the eastern Wadi Sebbeh, while B guarded the road towards the Dead Sea. The access point from the inside to the outside was the only eastern passage and it was overseen by camp C. In the North, camp D controlled Wadi Nimre from its northern bank. From here a new stretch of wall ran west up the cliff. The top of the western rocky side was controlled by camp F, also responsible for overseeing the road to Hebron/Jerusalem. The daily

provision transportations were organized from here to supply the legions as well as the *canabae* located in the west, outside of the wall.

South to the F camp was settled camp E, probably to protect the so-called Engineers' Yard. The wall continued south, connecting camp G (that controlled the western section of the Wadi Sebbeh) to camp H, located on top of a plateau rather like Masada and separated by a wide and deep longitudinal crevice.

There are evident differences among the camps, starting with their size, depending to the function of the camp itself. Camps B and F, as well as what is left of camp C' s first phase, are bigger than the other settlements and they have doors on all four sides. They are distant from the wall and hindmost, to offer better protection. Most of the legion was quartered here, deployed according to the system we described earlier. Camps D and H are the smallest ones and, besides serving for protection, they were probably used to communicate between the eastern and western camps on either side of the mountain. The wall and the turrets were about 2 to 3 m high – the ruins found are about 2 m at their highest point. Camps A, E and G were only used as protection and to ease the changing of the guard. The ruins found suggest there were only a few soldiers in these camps, probably one *centuria* each. The entry doors are not *claviculae*, instead they are simple gaps in the wall. The so-called Engineers' Yard doesn' t have any special defenses, nor does it suggest the presence of buildings inside of it. It probably indicates this was the fenced area where the war machines (and probably the siege tower) were built. The shape of the doors varied according to the historical period, the type of camp and the type of entrance. During the 1st century, we see the introduction of a new type of entrance in military environment, the so-called *clavicular* [Cichorius 1900] – small key – due to its shape (Fig. 8). The opening is an extension of the wall in the shape of a quarter circle, oriented towards the inside or the outside of the camp. This was done to show the soldier' s right side to whoever came through, i.e. the side not protected by the shield. In Israel we can find the first examples introduced by Vespasian (for example at Masada), as well as the last ones at Nahal Hever, dating back to the 3rd Jewish War (or the Bar Kohba insurrection, that lasted about 70 years from 70 to 135 CE).



Fig. 8. *Clavicular* doors. On the left Masada, Camp F; on the right the remains of a camp, Nahal Hever. © MRP

The major camps F and B, that covered about 20 thousand square meters each, were the only ones presenting *clavicular* doors. During the after-siege occupation, F was reduced to F2, B was completely abandoned, and C was also reduced. Camp C' s original extension is hard to trace, because it' s only in part visible on the terrain.

The Masada Research Project focused on the analysis of Camp F2 (Fig. 9) because of its distinctive fortifications, the archaeological surveys conducted and the previous studies available. Extensive laser and photogrammetric surveys were realized, as well as a deep archaeological study that allowed reconstructing the actual height of the fencing wall. Some hypothetical studies of the *contubernia* are still ongoing.

(D.B.)



Fig. 9. Camp F from Herod Villa. Author's photo. © MRP

THE ANALYSIS OF CAMP F2

Considering the landscape representations of the beginning of the Century, there are only two measurable maps of the temporary Roman camps. The first ones were created in 1962 by Richmond (Fig. 7), but cannot be considered reliable because sketched in England by the author after a one-day trip to the main camps. Richmond traced his drawings off the aerial pictures taken by the RAF airplanes. The maps roughly describe all camps except for camp H, located on a barely accessible rocky side of the mountain. The second, essential representation is limited to camp F and was created by Goldfus and Arubas between the years 1995 and 2000 [Goldfus and Arubas 2000]. This map is the result of the first stratigraphic surveys conducted in the northwestern area of camp F (renamed camp F2) from which a new, detailed planimetry is created. On this planimetry, all investigated structures were numbered and named.

As we can deduct from the remains of the spaces and from the pottery collected on site, this camp was probably only occupied for a few years (30 at the most), until the annexation of this region to the Arabian Province between the years 106 and 113 CE [Goldfus 2010].

Camp F2 was obtained from camp F at the end of the siege, by demolishing some of the structures to reuse their building material and create two new access points, one North and one East. The camp took advantage of the western rocky side as natural defense. The structures in the camp didn't follow the classic arrangement of the legionary camp described by Hyginus Gromaticus [Gromaticus passim], but they did respect some of the fundamental principles: the legionary contubernia (some highlighted in Unit II - Fig. 11) are built next to the eastern defensive perimeter, but exploit the terrain's natural shape on the west side, probably to find shelter from the atmospheric agents; in the center we find permanent-looking buildings, among which is the praetorium - Unit I (Fig. 11), facing the enemy. The wall was reinforced with square-sectioned structures built at the same time. This can be seen very well next to door E, where the lithic blocks form right angles. The whole top of the wall is gone, because the structure crumbled to the east and is still visible in the several in situ collapses discovered along the perimeter of

the camp. Very strong earthquakes occur periodically in this area, the most recent registered in 1927 by A. Schulten during his stay at Masada.

The clavicula doors were rebuilt with reduced dimensions (6 x 6 m or 20 x 20 Roman ft., as opposed to the 10 x 10 m, 30 x 30 Roman ft of Camp F1). This was probably done because a smaller access point allowed better control and a smaller security detail.

(D.B.)

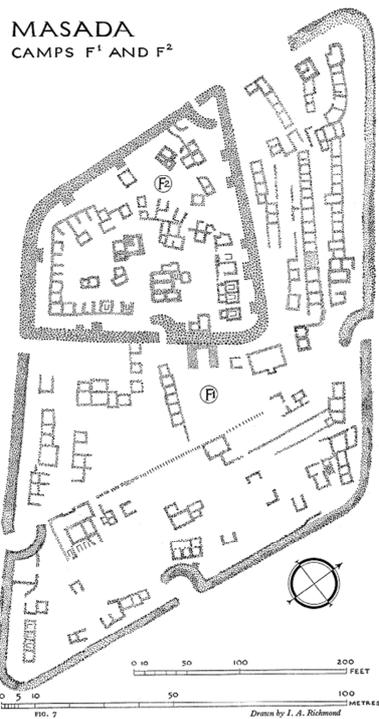


Fig. 10. Map of Camp F (F1 and F2). © [Richmond 1962]

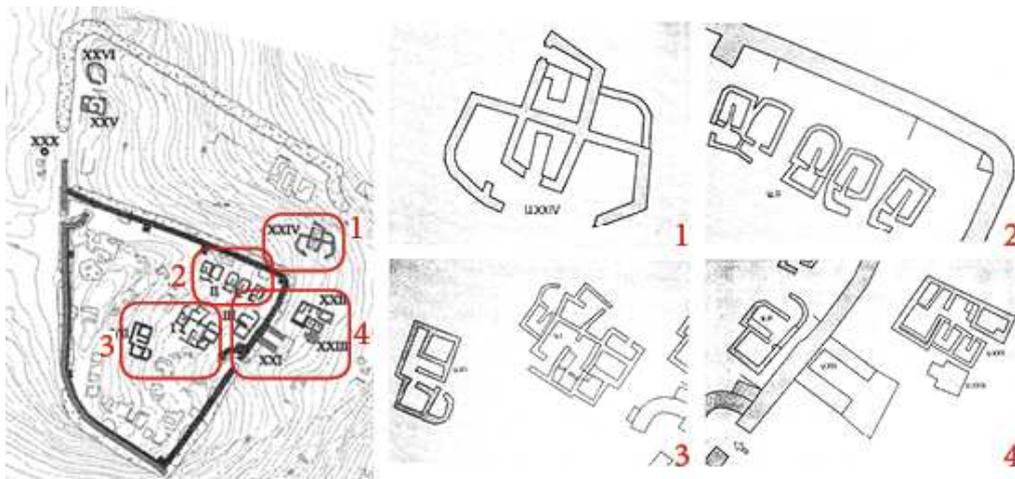


Fig. 11. Map of Camp F2, archaeological excavation. © [Goldfus and Arubas 2000] 1) Unit XXIV – (Maybe) centurion/cavalry contubernium; 2) Unit II – Contubernia; 3) Unit I – Principia (headquarters/commander's structure); 4) Unit III – warehouse.

VIRTUAL ANASTYLOSIS OF CAMP F2'S SURROUNDING WALL

The integration of the different point clouds, laser and photogrammetric, are functional to a further control on the reliability of the metric data, allows the scholars, by aligning the reference systems, to focus the attention on the morphological complexity.

The point cloud, a three-dimensional database, must be ordered to define an organic system and to structure the data of the continuous system in a new configuration whose reasons can be inferred by a semantic reading of the forms of the built for discretization and simplification of archaeological spatial data.

Through SFM (Structure from Motion) was possible to obtain 3D database and 3D models suitable for virtual transposition of an archaeological site for digital display platforms.

The result is a highly reliable model that can be manipulated and interconnected with other information system management tools.

Nowadays the digital archives are requested to include, in addition to images, texts and graphics, even a digital documentation of considerable importance and consistency that must be structured in such a way that all the scholars of the different disciplines are able to draw.

The point cloud acquired from the laser scanner survey has allowed us to develop considerations and in-depth analysis on the typological elements present in the field such as the walls. Several parts of the wall were well preserved, especially in the northeastern area. Thus, it was possible to analyze the dry-stone walls and propose a virtual anastylosis of some of them. From the point cloud (Fig. 12) we can deduce a lot of information that, combined with the on-site investigation, allow us to pinpoint areas that were already studied archaeologically. This happened in the Unit XXI area, where the original external wall surface is clearly visible.

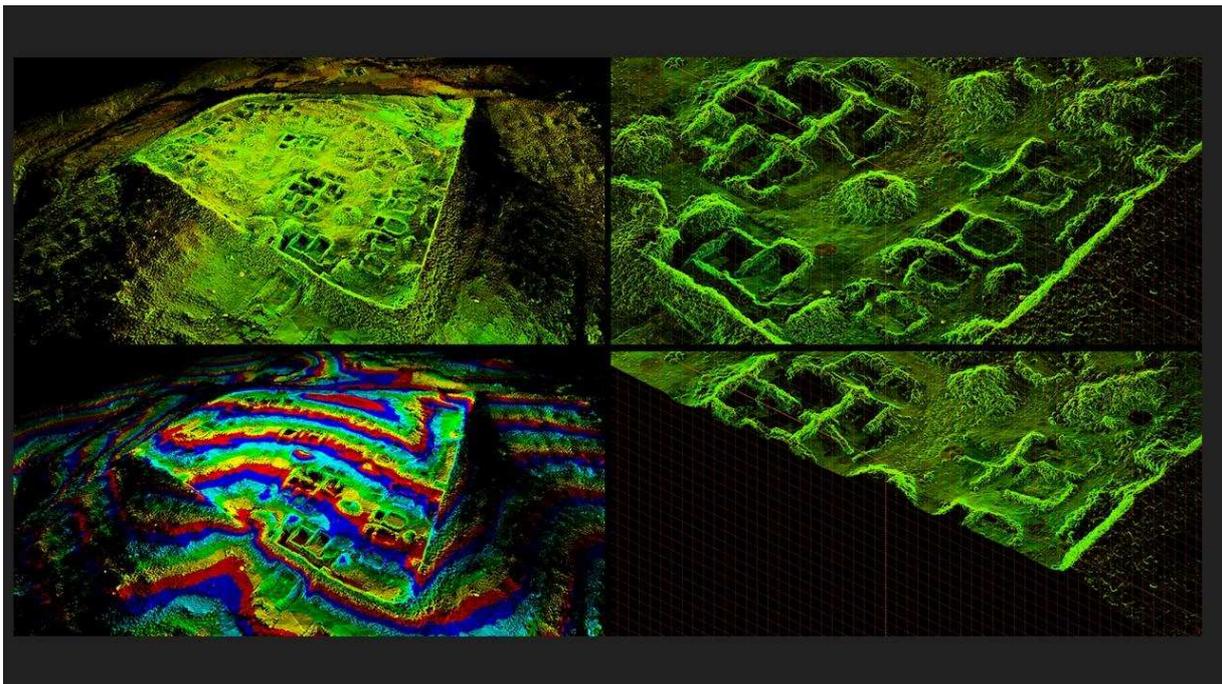


Fig. 12. Digital layout. Laser scanner survey, Camp F. © MRP

From the point cloud it was possible to extract several sections (Fig. 13), before and after Unit XXI, where the base of the wall is clearly visible and built on an *extra terram* part.

The extracted polylines describe its transversal sections that were superimposed and compared.

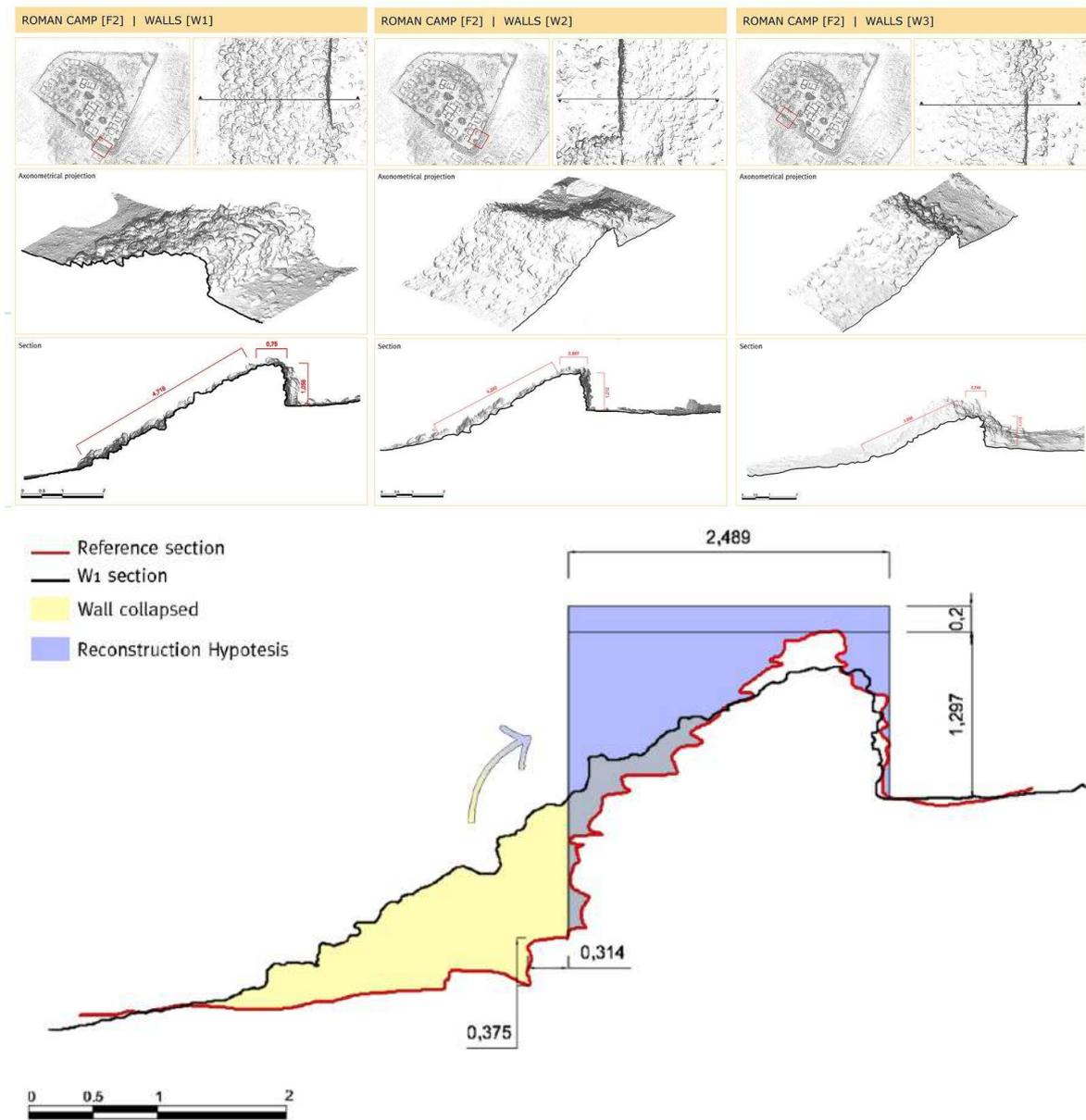


Fig. 13. Technical drawing. Transversal sections superimposed and compared. Virtual anastylosis of the original external wall. © MRP

From the graphic (Fig. 13) it is possible to identify the section of the sampled wall in relation to the archaeological operations (Reference Section in red) as well as the section of the wall itself located a few meters south, somewhere between the door and Unit XXI (W1 Section in black).

The planking level inside the camp against the wall is only visible for 1,3 m because it was raised by eroded debris that were transported through the centuries by meteoric water coming

from the western side of the camp – a raised area leaning East.

The wall constitutes a sort of dam that filters the water, retaining materials and debris. This phenomenon occurred in other parts of the site too, such as the praetoria door in camp F1, almost completely covered by a soil layer thin and clean.

By superimposing the profiles, it is possible to measure the thickness of the fencing wall, its actual height (thanks to the identification of its set-off base) and the amount of material that crumbled to east (Fig. 13 - yellow area).

The yellow area geometrically corresponds with the blue area (reconstruction hypothesis).

We infer that the preserved wall is almost complete when compared to the original structure, which height is estimated around 1,5 m (5 Roman ft) and thickness around 2,5 m (8 roman ft).

Further confirmation comes from the historic literature: among the good practices to build a camp, Hyginus listed the construction of a fencing wall that must be 2,4 m (8 Roman ft) thick and 1,7 m (6 roman ft) tall at the most. The wall was to be built using dry-stone and clumps of soil [Gromaticus I, 50 – 53]. The proposed wall model can be recapped three-dimensionally with several representations.

(D.B.)

CONCLUSION

The point cloud obtained from the laser scanner survey allowed developing considerations and in-depth analysis on the typological elements present in the field: the walls, analyzed in several points, a structure interpreted by Goldfus and Arubas as a second phase contubernium (field F2), permanent buildings, turrets and artillery platforms. The outcomes of the following studies were first collected in a census-like documentation consisting of filings on the individual wall sections, to then be translated into 3D drawings and models that constituted an abacus of the elements present in the field.

The primary purpose of the research carried out on the Roman camp F2, is to use the tools of survey and representation, to analyze the survived archaeological elevations and to reconstruct their original shape, both metric and material. Thus, the representation through 3D modeling becomes necessary for the reading of drawings, traits and essential characters of the archaeological artifacts in order to ensure a deeper knowledge of their cultural and historical value and to guide the selection of most suitable communication systems.

Basing on the two-dimensional elaborates produced and following considerations of in-depth analysis on building typologies, the virtual reconstruction of the Roman camp is predisposed. The operative methodology, here applied to a defined case series, is characterized by its wide applicability and repeatability on contexts and themes like the one under examination: we proceeded by defining a module (corresponding to a Roman foot) to represent the volumes of the walls. In the case of the wall, thanks to the study on the sections, it was possible to establish the size of the masonry of about 5x8 modules (Fig. 14)

The results of this first experimentation are expressed in three main aspects: the experimentation of a reliable survey conducted with digital technologies on a temporary Roman camp, the characterization of the qualities of the survey in the analysis of survived ruins; the characterization of the existing according to the measurement possibilities offered by the digital survey.

The remote control of the Roman camp and the possibility of orbiting the point cloud by freely navigating a system in three dimensions of the historical site, that for many environmental reasons is not appreciable in its real use, has shown here the first steps of a research that intends to provide, to archaeologists and archaeologists, innovative reading instruments for the realization of measurements and the experimentation of hypotheses of more reliable reconstructions [Parrinello et al. 2017].

Thus, the archaeology represented, filtered by modes of reading and data collection, becomes the mirror of the past reality and can be understood as a simulacrum for the development of descriptive tools useful for planning multiple scenarios in which the past can be preserved. In this sense, the digital drawing archeological sites involves the reading of the past to define the present and plan the future, through experimental models functional to the definition of the virtual space, intended as space of symbols and cognitive networks.

(S.P.)

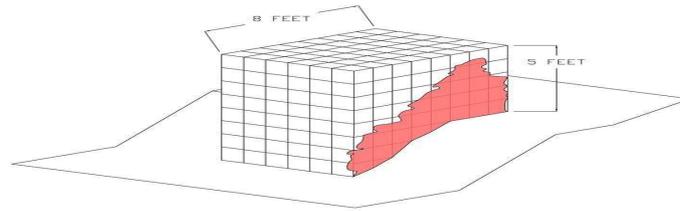


Figure 14. Digital layout. Three-dimensional reconstruction of the external wall. © MRP

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