

A program of International cooperation Italy-Israel

The Masada project was developed as an on-going research collaboration between the Department of Interior Building and Environment Design of Shenkar College of Design and Engineering, the Department of Architecture of the University of Florence and the Department of Architecture and Civil Engineering of the University of Pavia. Beyond the research aspects, the project has didactic aspects as well. The project, consisting in a proposal for digital documentation of Masada cultural heritage sites.

- II -

DIGITAL SURVEY IN ARCHEOLOGY

STEFANO BERTOCCI SANDRO PARRINELLO REBEKA VITAL

MASADA NOTEBOOKS

REPORT OF THE RESEARCH PROJECT 2014

VOL. II

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Elena Mariotti

Editing

Sara Bua

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Sara Bua

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*On cover: General view of the point cloud
and three-dimensional processing about
Herod's Palace area.*

Elaborated by Marco Benedetti.

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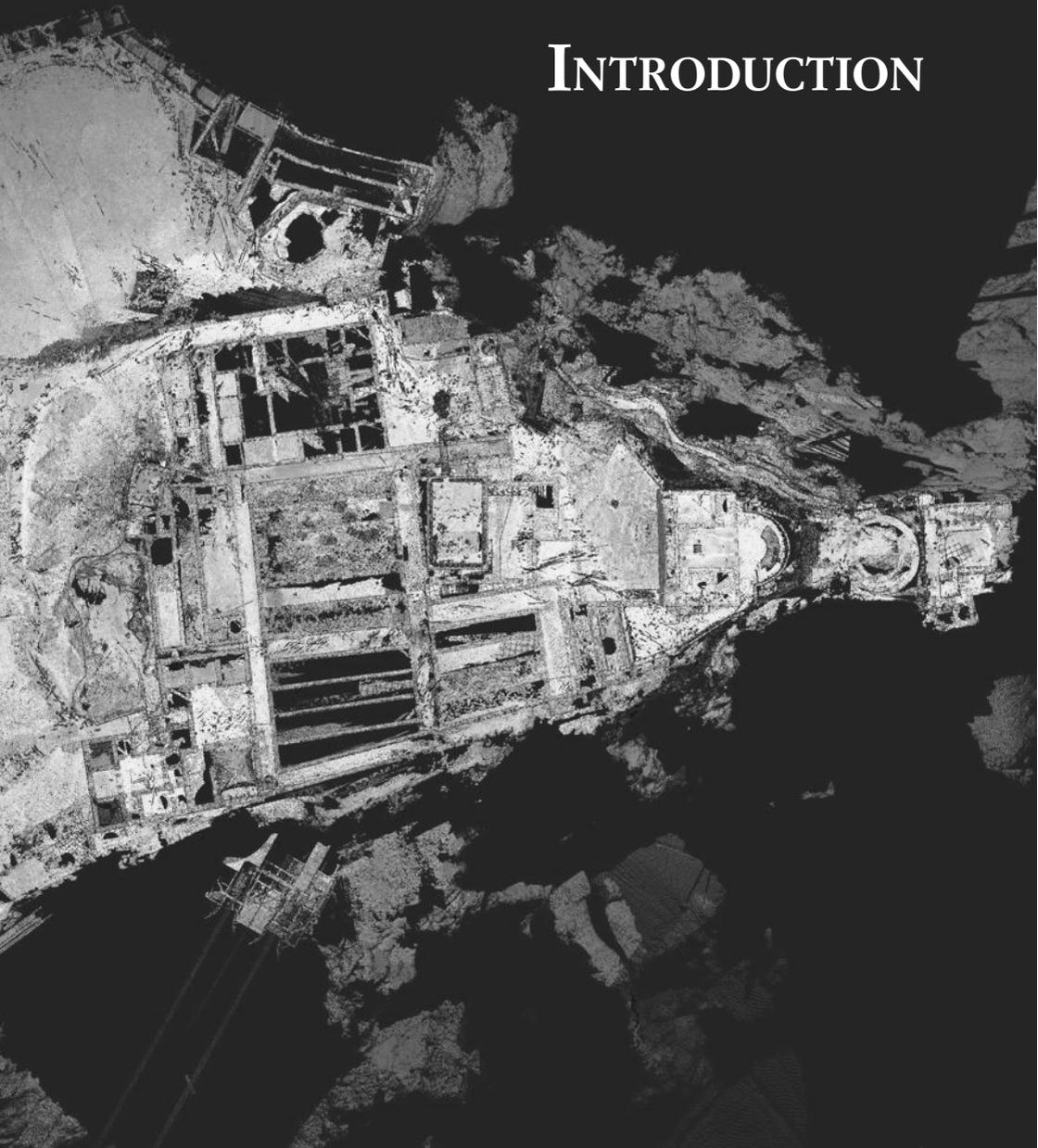
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INTRODUCTION



INTRODUCTION

Report of Masada Project

The project for the digital documentation of Masada fortress in Israel is part of the international research in the field of 3D digital documentation and mapping of culturally and historical important sites. A team of international researchers from the Department of Architecture of the University of Florence, the Department of Architecture and Civil Engineering of the University of Pavia and the Department of Interior Building and Environment design of Shenkar College of Design and Engineering from Israel, are executing a laser scanner survey, integrated with SFM applications, for the documentation of the Masada National Park in the framework of an ongoing research collaboration.

The University of Florence and the University of Pavia from the Italian side, together with Shenkar College of Design and Engineering from the Israeli side, have been working since 2012 on the digital survey of the UNESCO archaeological site of Masada (the cultural cooperation agreement between the universities has been in force since 26/06/2011). Other partners in the project include the Israel Nature and Parks Authority and, for technological support: Autodesk; Leica Geosystems; Mabat 3D Technologies Ltd. In the framework of this cooperation several academic activities took place in the field of digital documentation of cultural heritage:

- International Workshop: *Urban Archaeology in the centre of Florence: 3D laser scanner survey and 3D modelling*. (October 15 -18, 2012, Florence, Italy)
- International Workshop: *MASADA - International Architectural Workshop. How do we document a heritage site digitally?* (February 3 - 7, 2013, Masada, Israel)
- International Workshop: *The management of survey data for the construction of three-dimensional models from point clouds*. (October 3 – 8, 2013 - Pavia, Italy)

- International Conference: *The archaeological survey: experiences of Investigation* (October 9 - 10, 2013, Florence, Italy)
- Exhibition: *UNESCO Archaeological sites: experiences of Investigation* (October, 2013, Florence, Italy and February 2014, Masada Visitors Center, Israel)
- International Workshop: *Digital Preservation of "Villa Medici" of Florence – UNESCO heritage protected site* (September 2014, Florence, Italy).

A promotional film clip was made for the Masada project in 2013, which was screened for scientific outreach at various events, including the Conference on "Cultural Heritage and New Technologies" held in Vienna (October 2013), the "13th MEDIARC INTERNATIONAL FESTIVAL OF ARCHITECTURE IN VIDEO" (Florence, November 2013) and the Women festival "Conservation and Innovation / Architecture / Femininity: Preservation and Renewal in the realm of Contemporary Architecture" (Tel Aviv, March 2014).

The site of Masada, discovered in 1828 by a traveler on the rugged mountains that rise East of the Dead Sea in the southeastern Judea, is part of the Israel and is located about one hundred kilometers south-east from Jerusalem. The famous expert Schulte studied the site in 1933, but the great fortress was identified only during the excavation activities that were carried out from 1963 to 1965 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 is managed by the Israel Nature and Park Authorities National Parks, Nature Reserves, National Sites and Memorial Sites since 1998.

It became an UNESCO protected site in 2001 and today it is one of the most important archaeological parks in Israel. The complex is open to tourists and includes a Visitors' Centre, a cable cart for faster connection between the center and the main site area of the fortress, which is located on tableland plateau on the top of the mountain.

The main purpose of the researches that deal with wide archaeological

sites and complexes like Masada (considered in its territorial context) is to provide documentary evidences to every historic period shown by the archaeological stratification. No monument, no activity and no period should be considered more important than others, since the survey concerns the knowledge of the whole area in every aspect.

The analysis of the territory aims to find archaeological remains and to gather general statistical data about the history of the region. To accomplish that the research team carries out a laser scanning survey on an urban and terrestrial scale, completed by traditional methods of documentation.

The State of Israel owns the property and buffer zone of Masada, and the 1978 Antiquities Law protects the archaeological site. Since 1966, the entire Masada site and its surroundings have been designated as a National Park, controlled by the 1998 National Parks, Nature Reserves, National Sites and Memorial Sites Law. The National Park of Masada is further protected because it is entirely located inside the Judean Desert Nature Reserve, established under the 1998 Act. An important aspect of the actual management plan of the site, included in the UNESCO World Heritage Site in 2001, is the decision to proceed without further research excavations on the main site “in the period of the current generation,” limiting this type of activity only to the finalization of projects for the conservation, maintenance or restoration. According to the UNESCO Declaration of Authenticity (2010): *“This is a site that remained untouched for more than thirteen centuries. The buildings and other evidence of human settlement gradually collapsed and were covered over until they were revealed in the 1960s. There have been no additions or reconstruction, beyond an acceptable level of anastylosis, and inappropriate materials used in early conservation projects are being replaced. Limited restoration works have been carried out to aid visitor interpretation with original archaeological levels being clearly defined by a prominent black line set in the new mortar joints. Certain significant archaeological elements, such as the Roman camps and siegeworks, remain virtually untouched. The authenticity is therefore of a very high level”*. A new visitor centre was opened in the year 2000 in the valley, next to the Dead Sea, in the eastern side of Masada.

The cable car, an important link with the park entrance and visitor centre, which was originally installed in 1970, has now been replaced by a newer and less invasive facility. However, it is still possible to undertake the arduous climb to the summit through the two historical paths of access to the fortress.

The site is now subject to various types of risk: seismic risk (the site sits close the African-Eurasian fault line); hydraulic risk (the soil is very dry through all the year and occasional storms can create strong currents of rainwater); tourist pressure (the site, since 2000 has the prevision of 1.25 million visitors per year and is enjoyed by thousands of tourists every day during summer); sun exposure (most of the site is exposed to direct sunlight and high temperatures); war / terrorism (the unstable political situation in the Middle East exposes the site to terrorist or war accident). The general aim of the project is to create a comprehensive digital documentation of the archaeological site of Masada. The data acquisition has been done through laser scanning and photogrammetry. The point cloud, obtained by scanning the site, was acquired as raw data and was part of the documentation database. Further, the team has processed the point cloud in order to extract data needed to make 2D as-built drawings (plans, sections and elevations), 3D renderings and 2D and 3D details of the elements of interest located in the building.

The overall objective of the project is to create a complete digital documentation of the archaeological site of Masada through the acquisition of metrically reliable data, which will allow the production of a documentary apparatus. This will be accessible through a dedicated website with various levels of interface sections fit for various types of users, from the scientist to the tourist. Three-dimensional models can represent the site “as-is” but can also serve as the basis for a digital reconstruction that will be able to illustrate the state of knowledge about the site and the various transformations it underwent during the course of history.

The program includes a series of measurement campaigns organized in a period of three years (extendable if the opportunity to develop projects for satellite tracking of the whole territory becomes possible). In 2013 and 2014, during the first and second campaign (The partial results of the first mission were collected and disseminated through the publica-

tion of a report on the mission: S. Bertocci, S. Parrinello, R. Vital, *Masada notebooks. Report of the research project 2013*, Vol. I.), the program achieved the following objectives:

- Acquisition of digital 3D survey of two-thirds of the archaeological site with a registered point cloud, consisting of more than 200 laser scanner sessions, covering the northern edge of the site until the Byzantine church and the elevation of the building to the north west.
- Creation of a database of digital raw data that served as a basis for 2D and 3D documentation of the current state of the main buildings in the north of the site.
- High resolution digital photographic documentation of the site, consisting of both detailed pictures and low-altitude aerial pictures taken with a drone.
- Architectural drawings, extracted from the point cloud, relating to the northern palace and to the complex of the warehouses.
- Three dimensional textured models of areas of the northern palace.

The project of digital mapping does not preclude the traditional archaeological survey of the area (based on direct observation), the interpretation of aerial photographs and any geophysical prospecting.

Among the aims of this project, besides the necessity to create a complete digital documentation of the current status of the site, is the development of opportunities for a cultural partnerships between Italian and Israeli academic institutions. In fact, we want to try to develop opportunities of studying (for both Israeli and Italian students) the most innovative techniques of digital documentation of the architectural and archaeological heritage. We believe that this will create better opportunities to preserve historical heritage for institutions, companies or academies that take care of the protection of these monuments.

Stefano Bertocci, Sandro Parrinello, Rebeka Vital

The Archeological survey as a basical documentation for the conservation of the site of Masada

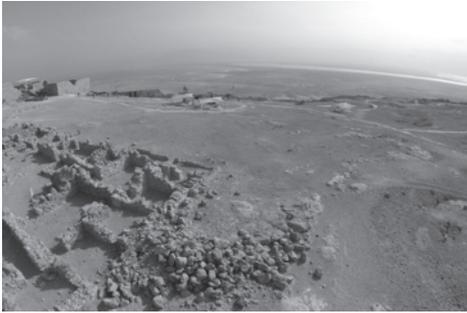
Stefano Bertocci

The project of a new digital survey of the Masada site, based on 3D laser scanning technology, could replace the giant survey work carried out from 1963 to 1965 by the Israeli mission led by the archaeologist Yigael Yadin¹.

The book, published after Yadin's death, shows a detailed archaeological survey of all the buildings whose remains are visible on the plateau. The survey work of all the buildings on the plateau is accurate, with valuable information about construction phases encountered during the excavation. Now, Yadin's survey constitutes a valuable database of the actual state of the excavations in those years. Today the site has undergone many changes and, in particular, some of the steps that are shown in the archaeological surveys have disappeared. This fact is due to the subsequent implementation of maintenance work or to the intense presence of tourists in the area.

Thus the current situation of the archaeological site appears to be quite different from the one documented by Yadin's surveys. During the last years there have been numerous works of consolidation and restoration of the artefacts, some structures have also been created for the adaptation of the archaeological sight-seeing, such as paved paths, parking areas with roofing, services and last but not least, the installation of the cable cart located on the eastern side, just above the "sneak path".

View of the Herode's Palace from the roman camp surrounding Masada.



View of the top of Masada fortress and view of the installation of the cable cart located on the eastern side, just above the "sneak path".

We have based our work also on the further aerophotogrammetric study of the area, which produced a complete topographic map conducted at a nominal scale of 1: 400 in 2004, with a careful drawing of the topography of the site, with contour lines at a spacing of 25 cm.

Nevertheless, the documentation of the site lacked all aspects relating to the height of the walls: Yadin's surveys show only certain sections of environments with more complex stratigraphic aspects. The documentation of the remains of the walls, including sections, is needed to understand the articulation of architectural structures, to document the stratigraphy of the interventions on the walls, the complexity of the surfaces, from decorative finishes to painted plaster and, last but not least, the static aspect of the structures.

For these reasons it was necessary to plan a new survey that is using 3D laser scanning technology, with high reliability metrics, able to document the complexity of the environment in all the aspects of the space.

This type of survey has been accompanied with the latest generation of photogrammetric methods in order to integrate the data of all those portions that are difficult to reach with the laser scanner or to make integrations of those areas particularly rich in architectural and decorative details.

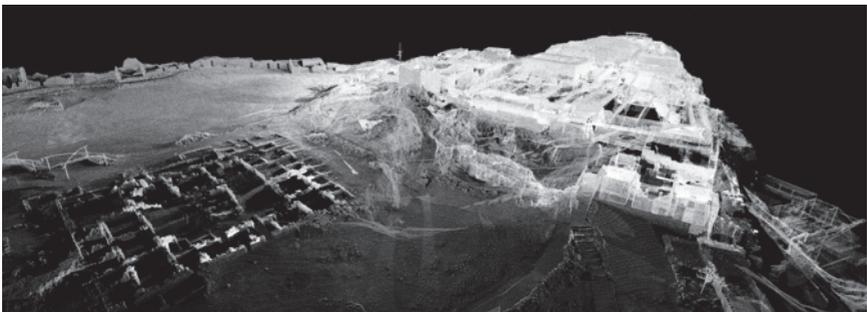
For the sake of the conservation project and analysis of the actual state of the site, it is essential to have a digital 3D relief, a map that will be able to support all the necessary technical information.

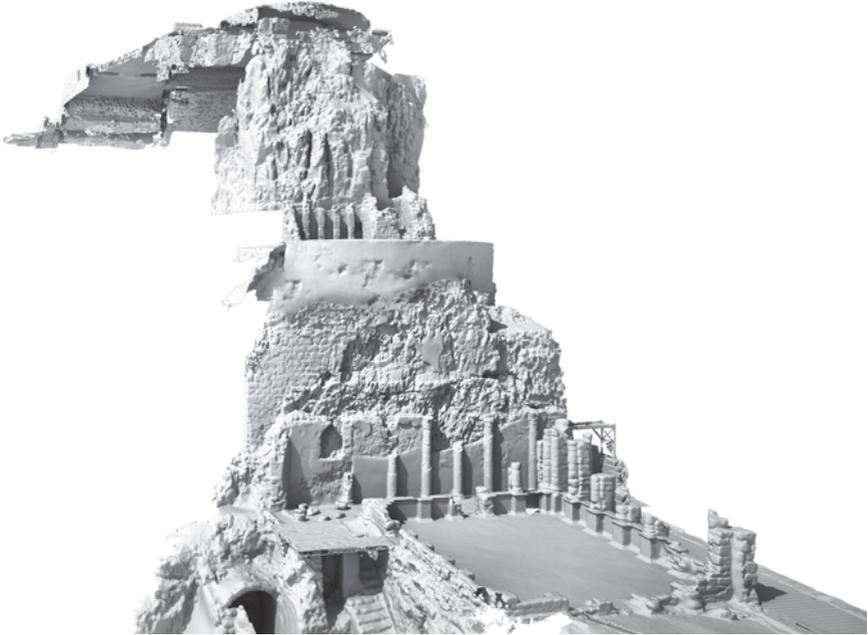
In this sense, the digital 3D model becomes a gateway to access the database, useful for the conservation of historical data, metric data and documentations of various types.

This project will have further opportunities for processing and output, like museum display and educational purposes; virtual tours will also be available online with multiple possibilities of access, starting from touristic and teaching, to the more specialized use that would include the highest contents for scientific scholars and specialists.

The first mission of our group of study in the site of Masada took place on February 2013 and dealt with the morphometric survey campaign of the Northern Palace, the study and the comparison between digital photogrammetric applications and laser scanner surveys, the verification of the reliability of the instruments, the importance of the difficulties created by orographic conditions to realize the programmed steps of the digital survey, the study of environmental conditions and the definition of a systems able to collect and store data related to optimize the post production work.

Detail of the point cloud of the top of Masada.



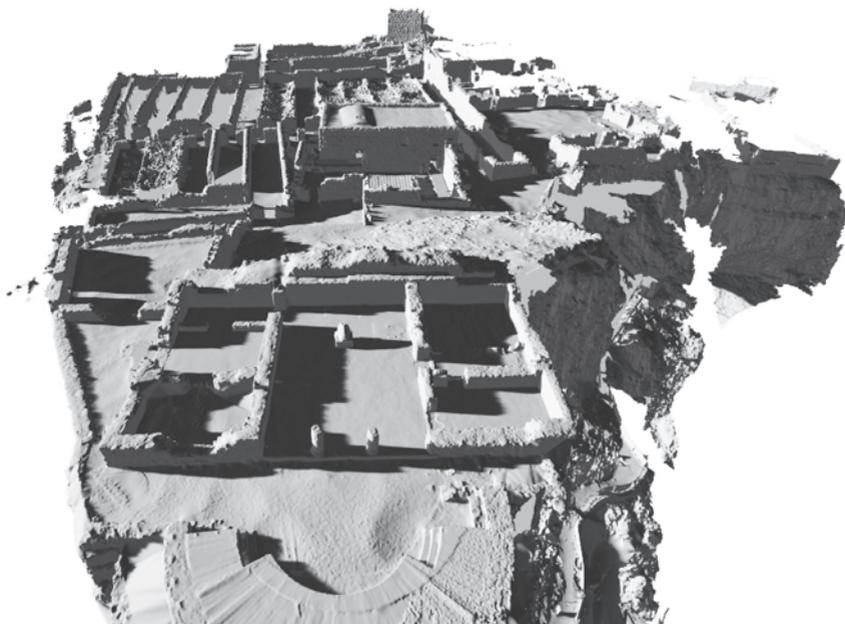


Three-dimensional modeling of the three terraces of the North Palace of Masada. Elaboration of Marco Benedetti.

The second mission of our group of study in the site took place on February 2014 and continued with the laser scanning 3D survey and the documentation of the emergency structures, which are nowadays present in the central plateau of Masada, and with the integration of GPS data.

Detailed surveys at the architectural scale and an extensive photographic campaign were conducted, aiming at the acquisition of three types of photo's data:

- Photography campaign for the documentation of the site and for the construction of photo-plans of the walls in high texture that will deliver high-quality wall weaving;
- Photography campaign aiming to photomodelling technologies, which will deliver 3D models equipped with textures;



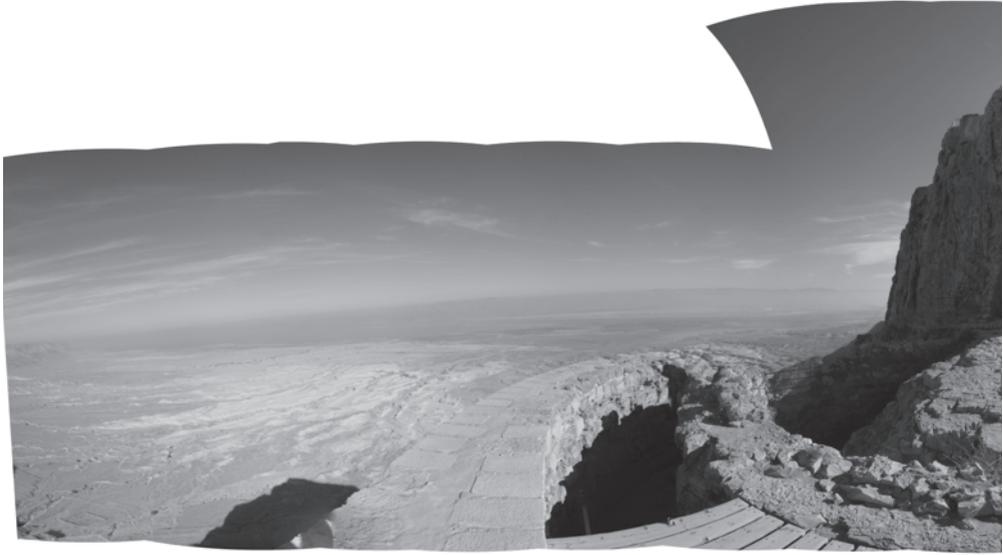
- Panoramic photography campaign covering the entire archaeological area in order to edit a smooth virtual navigation mode (a sort of “Street View”).

The documentation of the artefacts present in the central part of the plateau of Masada obtained in the second mission included: the system of four large buildings, the system of the walls of the fortification (the documentation is now up to 2/3 of the inner perimeter), the completion of the northern area with the smaller buildings connected to the system of warehouses of the main building (the Northern Palace) and some portions of the Byzantine settlement with the church.

The topographic reference system established by the early findings of Yadin was maintained to ensure the consistency of the whole system.

Three-dimensional modeling of the upper terrace of the North Palace, the building of the baths and the area of the warehouses.

Elaboration of Marco Benedetti.



Development of a panoramic photography of the North Palace.

This system consists of a regular grid, referring to the geographic coordinates of the site, in which each quadrant is identified by a coding alphanumeric system arranged from the abscissa and ordinate system. Within each quadrant, the buildings are coded and all the rooms located inside have a dedicated numeric reference.

The survey work at the architectural level allows us to start defining in a better way the documentation of the main artefacts on the site, which have been classified and categorized to allow a consistent treatment of information in order to revisit the data aimed for further study.

In particular, we expect to achieve coverage, with photo-plans, of all the exposed walls of the main buildings, to obtain a detailed catalogue for the comparison of masonry typologies and of the building technologies. This catalogue will allow us to define a complete atlas of the types of technologies and equipment used



in masonry on the site, in view of possible studies and comparisons with similar examples in the same geographic area.

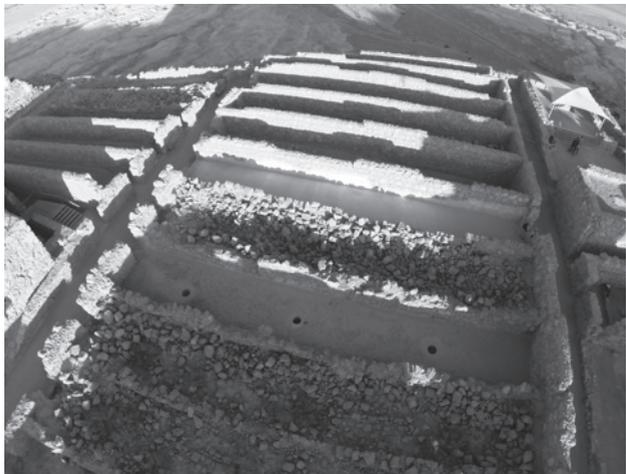
Characters of the archaeological site and typologies of artefacts.

As many historians stated, Titus Flavius Josephus among them, the site on the top of the hill of Masada has been used as a fortification also before the second century BC, due to its positioning on a rocky isolated mountain with only two access roads.

A big artificial underground cistern, together with numerous other basins for water conservation, both on the top of the site and on the steep slopes of the mountain, demonstrate the long-time human presence in the area.

View of the cistern situated on the south of the plateau.

View of the area of the store, at the North Palace.



On top of the hill, at a height of about four hundred meters above the Dead Sea depression, there is a flat-land with an area measuring about ten hectares. This summit plateau is fenced by a walled curtain that extends for about 1,300 meters, and inside the fortified wall, in the northern area, the most important building complex is located. The structure includes a large complex of storehouses, made up of two series of buildings with long rooms (from 20 to 27 meters) and an inner network of roads, as well as the wide residences with inner courtyards, including the famous palace of Herod.

The latter is an amazing monumental complex located on three terraces of the rocky summit over the desert and facing the beautiful landscape of the Dead Sea. Other complexes with various residential buildings and palaces are located in the southwestern area of the fortified site and each one of them consists of various rooms distributed around courtyards. In the central part of the plateau, there are the remains of a building belonging to the Byzantine period, a church with a central plan, which allows us to assume that the settlement inside the fortress existed at least up to that period. Well-preserved are also the ruins of the great structures, used to besiege Masada, built by the Romans between 72 and 73 AC, consisting of a fortified wall surrounding the hill, reinforced by the presence of eight military camps, with the traditional quadrilateral plan structure.

Netzer² established a division into three main phases of the development of the fortress of the Herodian period. The establishment of the major buildings in the central plateau is referred to the first stage, which lasts from 37 BC to 30 BC. These structures usually have a square layout, consisting of several rooms arranged around a central courtyard. In contrast to the northern part of the plateau, this area presents a number of in-



Views by drone of the Western Palace.

dependent, well defined structures, counting, mainly, the Western Palace and the buildings n. 9, 11, 12 and 13. The Western Palace is the only building that, from a separate unit in its earliest phase (the Core), evolved into a conglomerate of blocks and was ultimately even linked up with the Casmate Wall. It seems that all the buildings were erected without regard for a regular layout or orientation, selecting their sites mainly on the basis of topographic considerations that the summit area allowed for. Building n. 9 is a rectangle, approximately 38.5 m long and 30.0 m wide, to which structures that belongs to several periods were added, both inside and outside. The original building was erected with a large central courtyard, flanked on the North, West and South by nine identical units, three on each side. Each unit consisted of a large room, entered through a doorway in the central courtyard, and two small square rooms.



On the fourth eastern side stood three rooms, of which the central one was the entrance to the entire building. Two additional units, similar to halls, were found at the north-western and south-western corners of the building.

The later additions to the original Herodian building, as Yadin suggests in his analysis, were assigned mostly to the Zealot period with the exception of a few post-Zealot parts (mainly to the northwest) and some Byzantine structures (mainly one building in the middle of the central courtyard).

With the exception of the northern section, the Western Palace constitutes the largest structure on Masada. Though the palace, which consists of numerous wings, has an irregular shape, it approximates a rectangle of maximum length ca. 75 m and maximum width ca. 50 m.. Yadin conceived a scheme in which the palace consists essentially of three main blocks: the south-eastern

Views by drone of the buildings 9, 11, 12 and 13.

block (living quarters and services), the north-eastern block (services and living quarters for the administrative personnel) and the western block (storerooms).

However, as the excavations proceeded, the two architects of the expedition, Dunayevsky and Netzer, arrived at a different conception. In their view, the history of the palace should be divided into two phases (parallel to the similar phases identified at the same time in the northern section). The first building phase comprised the Core of the palace, the Eastern Service Wing, the Western Service Wing and the first stage of the Side Entrance Wing. The remaining parts of the palace were built in the second phase, to which the Casemate Walls of Masada is also ascribed³.

Buildings 11, 12 and 13 constitute the so-called small palaces because of their typological resemblance to the Core of the Western Palace.



The above-mentioned similarity applies mainly to the original Herodian stage of the three palaces. During the Zealot period the developments of each building was different.

Building n. 11 is rectangular in shape, of length 15.5 m. and width 13.5 m.. It stands at the highest point of Masada, in a central position, also allowing an overview of most of the cliff top.

The main entrance was in the north. In the centre of the building there is a relatively small courtyard. To its south lies the open reception room which opens onto the courtyard through a distyle. The building was in use, most probably without interruption or alteration, from the time of its construction up to the Zealot period.

Building No. 13 is a rectangular structure, 19.5 m in length and 14.7 m in width. It stands near the centre of Masada, southwest of Building No. 11, on fairly level ground. The entrance was from the north. In contrast to Buildings No. 11 and 12, the “central” courtyard was not in the centre of the building, but on its side, adjacent to the western wall; all the rooms surround the courtyard on the north, east and south. The opening to the south of the courtyard, through a distyle in *antis*, was the open reception room. A rectangular structure was attached on the south; the rooms of the annex were built on the west and south of its courtyard, which occupied the north-eastern part of the new annex.

This part belongs probably to the first Herodian phase as do some other buildings such as the public immersion pool, the swimming pool, the round columbarium tower, the big southern water cistern, as well as two of the oldest towers of the city walls.

At the second Herodian phase from ca. 30 to 20, the whole Western Palace was completed, usually identified as Herod's palace, which includes the construc-

View by drone of the tower close to warehouses, to northern area.

tion of the monumental three terraces of the North and the construction of the large complex of the warehouses, made up of two series of buildings, consisting of long rooms separated by an inner network of roads with two parallel branches, three residences with inner courtyards and, probably in a later stage of the development of this phase, the thermal baths.

The Large Bathhouse was built as a self-contained unit, aligned in relation to the Northern Palace. This building didn't respect the ideal master plan of the area of the warehouses, but relates to the geometrical orientation of the three terraces of the palace. Some elements of the planning of this area, which were probably changed for the new Large Bathhouse, indicate different geometrical relations with the first phase of the warehouses.

The building is approximately 21 m by 20m, the baths are added with rectangular courtyard and an exedra that was enlarged in the late Herodian building phase by the addition of a room with a stepped pool.



On the top of the rocks of this area there is a guard tower that was probably built primarily to defend the Northern Section of Masada as a whole and the store-rooms in particular.

The Northern Palace was built over three natural terraces, in the northern end of this area the drop from the summit to the middle terrace is approximately 20 m, and the lower terrace is about 13 m farther down, which means 33 m below the summit.

The remains of the buildings indicate that they came from the same phase and were damaged several times, u in some cases by the flames that occurred when Masada was destroyed, but also by some natural catastrophes, such as earthquakes.

Nowadays, the access to the palace is through the northern square and the Entrance Courtyard. The three terraces were connected by staircases, located on the western side of the palace and are in the form of a staircase tower. The plan of the building states a strong geometrical shape of this area with the upper

View of the western gate and part of the walls.



*View of Masada with
the roman ramp.*

part ended by a semi-circular terrace porch overlooking the valley, the middle terrace with a circular porch building, and the lower terrace with a square porch.

The upper terrace consists primarily of two parts; the southern portion is a rectangular structure, to the north of which is a semicircular balcony. The rectangular structure, ca. 22 m long and ca. 12 m wide, features a large central hall, which is open to the north onto the semicircular balcony- through a distyle in antis. Flanking the hall on either side (west and east), were two remains of frescoes and mosaics. The semicircular balcony was probably at least partly decorated with mosaics, and possibly also frescoes.

A *Tholos*, a circular structure with 15.3 m. of diameter, built on a square platform, occupies the main part of the middle terrace. To the south, against the cliff beneath the upper terrace, is an additional structure that is comprised by the remains of the staircases ascending to the upper terrace.



The lower terrace consists of a square area, with sides measuring ca. 18 m, flanked by lateral wings. The central area was probably a hall with large windows in the area between the half columns that appear on the interior and on the exterior surfaces of the walls.

The hall was surrounded on all four sides by porticoes that had a view of the surrounding landscape. The eastern wings contained in the substructure a small Roman bathhouse.

There were also substructures under the Eastern and Western Porticoes.

The third phase, which runs from 20 to 4a.C., saw the completion of the palaces north and west and the construction of the city wall with the “caserate system” on the edge of the summit plateau.

This summit plateau is fenced by a walled curtain that extends for about 1,300 meters, and it is made of a double wall, with an outer curtain and reinforcement towers and with an interior wall.



View by drone of the Synagogue.

The towers are connected by transverse walls that form a series of communicating compartments (called casemate system) with access from inside the walls, and gave cover to the defenders of the fortress. The entire system is the result of work carried out in succession and extensive reuse of pre-existing walls. The compartments were used as warehouses, arsenals and residences; a synagogue is located among all these spaces (which is considered one of the most ancient of the area) and some buildings were used as columbaria. The Casemate Wall actually ends at the south-eastern corner of the Northern Section on the eastern side of Masada, and at the north-western corner of Building No. 7 on the western side.

The remainder of the summit is bounded either by some of the structures of the “Acropolis” (the Northern Section proper), which were built at the very edge of the cliff, or by a single defence wall (in some limited sections).

Three gates were incorporated in the Casemate Wall: the Western Gate, the Southern Gate and the Snake Path (or Eastern) Gate. A fourth gate (the “Water Gate”), which provided access to the Northern Section, was not integrated into the Casemate Wall and



was closed in the later phases of the life of the fortress⁴. At the beginning of the Jewish revolt of A.D. 66 a group of zealots led by Menahem, occupied the fortress of Masada, and many Jews took refuge there after the fall of Jerusalem and the destruction of the Temple by Titus in 70. Two years later, Flavius Silva, the Roman Governor, decided to conquer this last stronghold of Jewish resistance⁵.

During the occupation of the Zealot fortress, several areas of the Herodian palaces were modified. Houses were created into many of the rooms of the casemates of the walls, as well as in some expansions of the buildings themselves. As is clear from the excavations of Yadin, small buildings were built against the central building, occupying the free area of the inner courtyard.

Well-preserved are also the ruins of the great structures for the siege of Masada, built by the Romans between 72 and 73 AC, consisting of a wall surrounding the hill, reinforced by the presence of eight military camps, fortified with the traditional quadrilateral plan structure.

Among the siege structures, the most impressive remains are those of the artificial ramp, built using earth and protected with wooden structures (some traces still exist nowadays), used as a sloping plane to reach the walls on the hilltop with a huge siege tower that is mentioned in the writings of Josephus.⁶

The remains of a Byzantine Church, with its Narthex in the foreground, is located at the centre of the summit. The walls have survived to a relatively great height. In some parts of the nave and also of the narthex, there are parts of mosaic floors.

There is also a byzantine building that consists of a built room and a group of caves, situated in the middle of the area of the summit.

*View by drone of the
Byzantine Church.*



Initial investigation of the Herodian fortifications system

The program of Herod for the construction of forts and fortified palaces was developed during his entire reign (37-4 BC), constituting the most important plan, from a military standpoint, for the territories of Judea, second only to the crusaders' military constructions for the fortification of the Latin kingdom of the East⁷. The works cover the whole territory at the time of his kingdom and have an amazing variety of artefacts that focused in particular to the realization of extraordinary residences, many of them with extraordinary fortifications, as well as a system of roads and ports. The expansion of the city included the construction of irrigation and hydraulic systems, as well as the construction of the new Temple in Jerusalem.

Many of the military installations were largely renovations or rehabilitation of existing sites that were also fortified. Given the fact that many of those forts were built renewed or completely rebuilt in a short lapse of time, the precise chronological references of those military installations are very difficult to define. In fact

many Herodian fortresses existed before Herod himself and are related to the Hasmonean era, especially during Janneus' reign, and even earlier. Herod's work on the fortifications doesn't seem to have followed a precise program; it rather seems that the choices of the sites were made by following particular strategic needs.

According to Josephus, Herod was able to establish his authority over Judea only after having surrendered the fortress of Hyrcania to the sister of Antigone. However, the result, considering also the construction of the Machareus and of a second Herodium, ensured a good protection to the borders located in the western sector of the Dead Sea. These fortresses were placed in the desert, usually on the top of the higher hills, allowing a good control of the communication routes along the Jordan River. These fortresses were used as local administrative and military centres, seasonal residences and refuges.

After Herod's death, the fortresses kept playing an important role as refuges during the first revolt against Rome. Herodium, Jericho and Machareus were occupied by the local people. When the uprising began, the Sicaris from Galilee occupied Masada. Later, given the morphological similarities of the three forts, the Romans were able to recapture Masada, Machareus and Herodium using similar strategies of siege.

Many authors stated that Herod's conspicuous constructive activity was based on the local building experiences mixed to the use of Roman constructive and decorative solutions.

The proposed models and technologies belonging to the hegemon empire had the function to support the adhesion to the political program of Rome in the East. The use of complex and articulated architectural orders is one the more remarkable characteristic of Herod's interventions. During the Hasmonean Era, an

order similar to the classic Doric was commonly used; while in the Herodian Period there is a greater use of the Ionic and Corinthian. Nevertheless, there are some examples of Doric architectural elements in the earlier palatial building of Masada. Often the architectural elements present a fine coating of coloured stucco.

The particular solution adopted for the angular pillars, with the heart shape section (due to the juxtaposition of two half columns to a quadrangular pillar), apparently is a feature of Herodian architecture⁸.

Conclusion

The technology progress in the field of archaeological survey, where the use of digital techniques is now consolidate (from the organization and the acquisition of data up to the post production), involves a series of consequences, the most significant of which appear to be the increasing of the amount of data and of acquired information. This gives us the need to keep pace with the technological progress in this field. This requirement translates into the ability to develop new documentation and dissemination methodologies in order to obtain the most from the digital potential.

For system consistency, but also for convenience in terms of space and time costs, all these results in the organization of a series of supports, which need to comply with the digital tools.

The database, the website and the interactive map are intended to be some concrete examples of the ability to structure the complexity of data accumulated, to organize open systems for benchmarking and disclosing information but, above all, to contribute to the preservation of an archaeological site that is truly a part of the human heritage.

NOTES

1. E. Netzer, *Masada III, The Yigael Yadin Excavations 1963-1965 Final Reports – The Buildings stratigraphy and Architecture*, Israel Exploration Society, Jerusalem, 1995. The work concerning the stratigraphy and architecture of the buildings of the site, began in 1989, after the death of Yadin in 1984, and was finally published in 1995. The author was Ehud Netzer, who participated to the expedition and, at the end of the excavation campaigns, he was the architect responsible for the preservation and restoration of the site before it was opened to the public in 1966.
2. E. Netzer, *Preface*, in *Masada III*, cit., p. XII. A revision dating has been suggested, on the basis of the ceramic materials, Early Herodian 37/31 – 28/26 B.C., Main Herodian 28/26 – 18/16 B.C., Late Herodian 18/16 BC – 6 A.D.
3. In the wake of the excavations carried out in Jericho (in the years 1973-1983), Netzer suggested that the Core of the Western Palace had been erected most probably before the Herodian sections of Masada, during the Hasmonean period. Cfr. E. Netzer, *Recent Discoveries in the Winter Palaces of Second Temple Times at Jericho*, Qadmoniot, 15 (1982), pp. 22-29.
4. A great number of various items of Roman and other military equipment were discovered in the extensive excavations at Masada, which were conducted under the direction of the late Professor Y. Yadin in two long seasons in 1963/4 and 1964/5. Yadin makes references to several of those military finds armor scales, arrowheads and ballista balls, in his preliminary report on the first season of the excavations in the *Israel Exploration Journal* n. 15 (1965), pp. 1–120. Cf. M.C. Bishop, J.C.N. Coulston, *Roman Military Equipment from the Punic Wars to the Fall of Rome*, London 1993; M. Feugère, *Weapons of the Romans*, Stroud, Gloucestershire 2002 (French original 1993); G.D. Stiebel, *The Militaria from Herodium*, in G.C. Bottini et alii (eds.), *One Land - Many Cultures. Archaeological Studies in Honour of S. Loffreda* (Jerusalem 2003), pp. 215–244.
5. Cf. Josephus Flavius, *The Jewish War*, edited by G. Vitucci, Arnoldo Mondadori Publisher, 2012 reprint, chapter VII, 8, p. 488.
6. The history Masada is known mostly thanks to Josephus Flavius' work, renowned Jewish historian lived during the first century A.C. For the description of the fortress and of the Roman siege works cf. Josephus Flavius, *The Jewish War* cit., chapter VII, 8, pp. 484-488.
7. L. Marino, *Le opere fortificate di Erode il Grande*, Cierre Edizioni, Verona, 1997; G.Prause, *Erode il Grande. Il re dei Giudei oltre il velo della diffamazione*, Milano 1981 (orig. Hamburg 1977); F. Zayadine, *Les fortifications pré-bellénistiques et bellénistiques en Transjordanie et en Palestine* in, P.Leriche e H.Tréziny (edd), *La fortification dans l'histoire du monete grec*, Paris 1986, p. 152.
8. The solution corner of the heart-shaped pillar is used also in the first century B.C. in the area of Nabatean Petra (in the interior of triclinium for example), and also appears in the late Roman period, for example in the pillars located on the head of the transept of the Church of Nativity Bethlehem.