THE "CUEVAS DE LOS MOROS" IN BOCAIRENTE (ES). ON THE INTEGRATED EXPEDITIOUS SURVEY.

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ABSTRACT:

The work supports the research on rocky settlements in the Mediterranean area and their diffusion. In particular, it provides the Valencian Community and the Municipality of Bocairente with the two-three-dimensional graphic documentation of the monument "Cuevas de Los Moros", apparently poor, which is the driving factor of the cultural economy of the country. The documentation created is a useful interdisciplinary tool for in-depth analysis of the place through historical, archaeological, and economic studies. The work has scientific rigor due to the methodically tackling data acquisition. It integrates the traditional instrumental survey, double-decametre, and level with photographic documentation and SFM processing. Furthermore, one of the objectives is to disseminate a correct methodological approach to documenting cultural heritage. The aim is to share and allocate among culturally motivated amateur operators to increase the documentation of a cultural heritage, which due to its widespread extension and apparent poverty, does not receive the necessary attention for promotion and conservation by the bodies responsible for the control of cultural heritage. Rock dwelling and its environmental system, as well as its rock-cut monuments, are recognized by Unesco.

1. MANUSCRIPT

1.1 Introduction

The culture of living in rock characterizes rocky landscapes worldwide and crosses civilizations and historical periods. (Crescenzia 2012). More and more rock areas and monuments enrich the Unesco Heritage. For example, in Italy, after the recognition of Matera, the project of inclusion and recognition as the Heritage of the cultural system of the territory of the Gravine is underway, a vast interregional Murgia territory between Basilicata and Puglia.
The cultural growth in the knowledge of the excavated settlements in the last 20 years is due to the growing attention to passive architecture to recover ancestral systems and forms that combine well with the current need for the project and its interpretation in the key of sustainability and ecology. (Navarro 2003). The attention of design architects leads to an interest that goes beyond the study of living systems developed over long periods by specific and widespread skills developed over long historical periods. Scholars attentive to the conscious and eco-friendly use of natural resources, such as Pietro Laureano, have focused their attention on the complexity of historicized sites' urban development to understand the essence of living in rock
The media attention and the development of mass tourism have led, in many cases, to the distortion of the unaware use of the urban development and design of the excavated buildings often entrusted to culturally unprepared operators. The focus on the building by subtraction is also involving the starchitects. Among his latest works, Jean Nouvel includes a resort under construction in the mountains of the Sharaan nature reserve. He declares, "Our project should not jeopardize what humanity and time have consecrated. It must celebrate the Nabateans designs and genius without caricaturing it. This act of creation becomes a true cultural act." (Nouvel 2020).

1.2 Geographic area

Spain is one of the Mediterranean countries that boasts numerous cave settlements. Although the settlements are extended throughout the territory, these are more present in the peninsula South and East due to their geological and climatic suitability to which sociocultural factors are added, that do not necessarily respond to the needs of poor populations. Therefore, the houses are present throughout the peninsula; the nuclei become more consistent in geographical areas where sedimentary rocks and low rainfall are combined. The houses were inhabited until the mid-twentieth century, they were abandoned and gradually destroyed over time after their initial conversion into spaces dedicated to agricultural activities. Currently, a process of recovery of eminently cultural character is being initiated, although associated with processes of tourism development in the interior counties, converting these spaces into touristic phenomena, which led to the beginning of its recovery and enhancement.
Among the geographical areas characterized by rock settlements, the Valencian Community and Murcia is one of the wealthiest regions with its 78 villages. Bocairente is one of the centers with rock-cut structures, among which we find the excellent and enigmatic site "Les Covetes dels Moros".
The investigation described in the article mainly focuses on the vertical wall settlement of the "Cuevas De Los Moros" in Bocairente and the survey techniques used for its documentation, carried out by a joint Erasmus seminar between the Department of Architecture of the University of Florence (DIDA) and the Polytechnic University of Valencia.

2. ON THE CUEVAS DELS MOROS

2.1 Location.

The Covetes dels Moros complex declared a Historic-Artistic monument since 1931, is located N-NE of the Bocairente village (38.770518, -0.606724). (Fig. 1) It is excavated in the calcarenite cliff that follows the gorge originating from the Barranco de Onteniente fluvial erosion. Therefore, it is a vertical plane settlement. (Fig.2)[1] We find other structures of the same type in its immediate vicinity[2].

Figure 1. In yellow is the location of the "Covetes dels Moros" and its relationship to the northern cape of the Bocairent urban center. https://www.google.it/maps/place/46880+Bocairente

The cliff exposure, which opens towards the North territory, hides the site from view from the terraces of the nearest houses. Currently, the site can be reached from the closest point of the Carrier Route de las covets, from here a mixed pedestrian track starts between stairs, steps and paths which, on ancient ways, descend to the bottom of the Barranco and climbs up, on the opposite rampart, to the crag foot.
The wall[3], with an almond shape whose maximum height is about 20 m, shows 50 effective openings and another 9 with only the beginning of excavation. The windows are located in the central part of the front on different levels without apparent order. They show no alignment either vertically or horizontally. This configuration, in contrast with the usual windows of built buildings, helps to create a fairy-tale idea of the settlement that stimulates tourists' curiosity. (Fig 2)

2.2 Description.

The settlement has its entrance 8 meters above the ground, on which five floors are divided (Triolet 1996)

Figure 2. Covetes dels Moros. Bocairente. Dense cloud from terrestrial photogrammetry. Data processing in Metashape-Pro.

Figure 2. Methods of access in vertical wall settlements (Matmata). Vertical, reverse and horizontal holds.

Three "climbing" routes are evident on the wall: holds and platforms mark the ancient entrance roads[4]. (Fig 2)
Currently, we access it with the help of two metal stairs placed at the building ends. Visiting the interior is easier if you walk through the building from North to South. The interior rooms develop flush with the wall; currently, they communicate through corridors and horizontal and vertical passages. Some of the latter are difficult to access.
The rock rings placed in pairs at almost every window[5] suggest that the rooms were single units merged only later; initially,

[1] The typological classification of rock settlements is taken from Navarro 2003; an in-depth analysis of the terminology of the typologies is in Crescenzi 2012.

[2] In Bocairent, we find structures of the same type within a radius of 700 m: at the foot of the village, two groups of windows open onto the rocky hillock that supports the houses. They are located on both sides of the "Roman bridge" and are called Pouet de San Vincent and Xorrador; The site of the Colomer, a single compartment, placed to guard the control of the valley a short distance from the Covetes; the group of En Gomar-Xorrador and that of Fos-Dolcainer (Triolet, 1996; Ribera, 2016). In the urban area, we find the rock nucleus of the Monastery of San Agustín, dated to the 16th century; this partly exploits a previous innovation; of interest, the water collection system.

[3] The wall has a South-Southwest exposure

[4] The access path to the rocky site is located under window 1 to the south, below window 37 -which also has two large rings in its way- and at the north end under window 44.

[5] The graphic synthesis in Triolet 1996 is excellent, where it is easy to read that almost every window has two anchoring rock rings, clearly visible from the outside. They find exceptions, such as openings 5 and 24 having only one outer ring. However, window 24 also has two rings in the inner corners. In opening 37, we find only the external southern ring, probably due to its partial collapse of the northern side; similarly affected by the failure is window 38, where the lower half of the window has disappeared. Window 42 is

ropes tied to them facilitated access to the structure. However, the three most marked access paths and some small distribution shafts could suggest belonging to three distinct family groups at least. This possible subdivision is also suggested by the internal vertical development shown by the section of the building. (Fig. 4).

Figure 4. Covetes dels Moros. Bocairente. S-SE Cross section. The rooms, to facilitate reading, have the numbering of Triolet (1996) and Gomez (2016) and the one that the seminar groups have adopted.

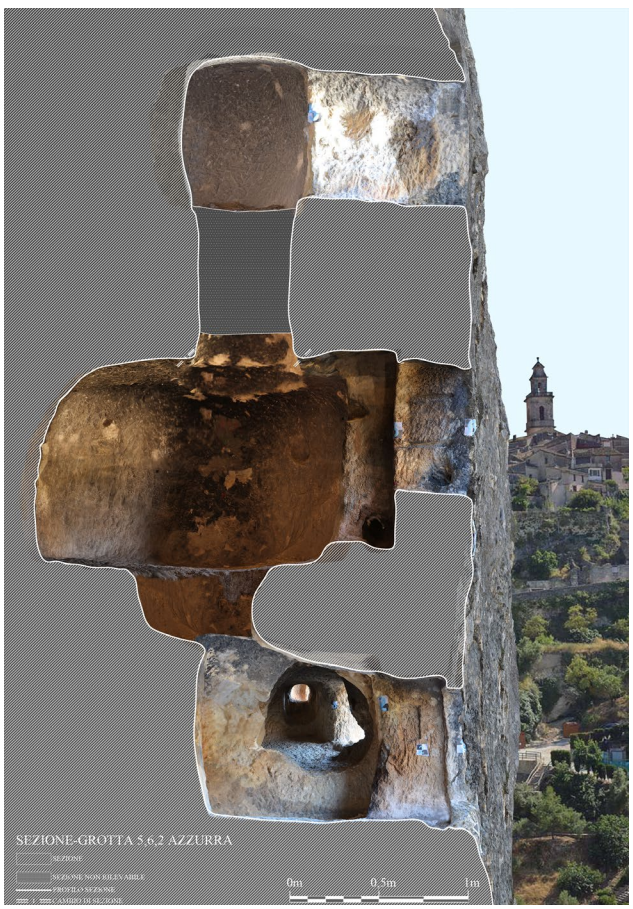

Figure 5. Vertical section for the blue rooms 5,6,2; the cutting planes are translated to intercept the non-aligned spaces; the cutting lines mark the translation points.

The windows, rectangular with similar dimensions (0.80m in height and 0.60m in width), have recesses and shaped jambs for installing closures. These and the problematic access made the building safe and secure.

The windows lead into as many rooms as, 9 of which are small; the latter are control elements for access and distribution to the groups of other habitable spaces. You need to move bent over or on all fours in most of them.

The rooms are arranged in succession and on different levels, communicating through horizontal and vertical bottlenecks that make it difficult to pass from one to the other (Fig. 5). These narrowings constitute internal control points that reinforce the external defence system formed by the difficult access to the vertical cliff face.

2.3 Interior furnishings.

Only a few rooms (5E) have rock rings as furnishings, smaller than those placed at the windows, and some of them are placed on the ceiling in correspondence with awkward vertical connections (1D, 1B). Some small circular wells were dug out on some floors and rock banks, which were used for crushing grains, seeds, or others (Fig. 5, 6). On some walls, we find small rooms for placing the lamps.

We find numerous writings with pencil, painting, or engravings but datable to the 20th century. On the left wall, entering room 33-4f-8blue (Fig.6), we see a Latin cross with crosses on the upper arms; a second cross was engraved in the cave 37-3k-5Bred.

The construction period of the building does not find agreement among scholars, nor does its use itself (Gomez 2016). The most accredited use of the building seems to be a protected deposit for personal goods, generically referred to as a granary.

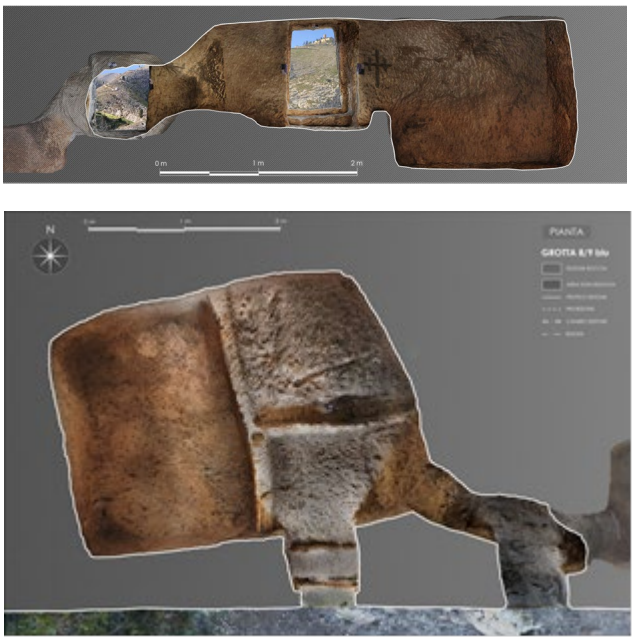

Figure 6. Covetos de los Moros. Bocairente. The 8-9 blue caves. Section and plan. Texturing in Metashape Pro.

The building seems to have been used as a safe storage for personal items, usually referred to as a granary. Similar carved-in-rock structures can be found in Turkey (the huge granary of TAŞKALE, Fig.) and southern Italy (e.g. the caves of Mago Greguro, Massafra- TA). The granaries of North Africa, while responding to the same need, are built differently; they have been carved above ground and have, in appearance, a different internal distribution.

without rings, although it is believed that it originally had them, like opening 1, where the rings probably disappeared due to the 1908 explosion (Vañó, 1985) to modify and make access easier. The aperture 10 has no rings on the outside but does have them on the inside corners of the access passage. They have none at all: 4, 7 and 42.

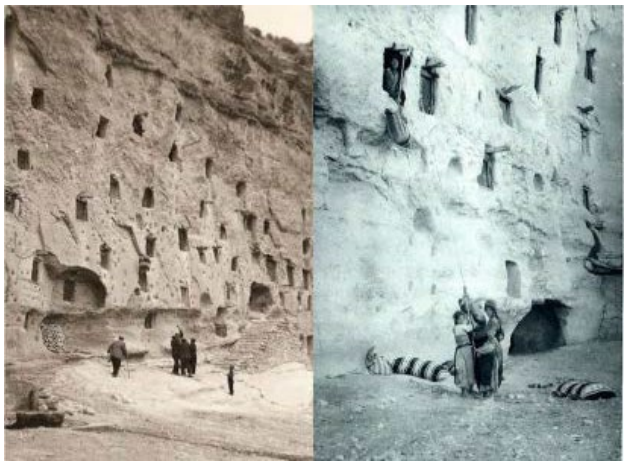

Figure 7. Carrying the products to the granaries using the pulley system (Taşkale Municipality archive. By Asrav 2015)

3. ORGANIZATION TO TAKE DATA SURVEY

3.1 Operating state.

Cave architectures are complicated to detect. Geometry and environment are conditioning the taking of data and their processing. The geographical location and the light factors influence the survey.

In the "*Casetes de los Moros*" of Bocairente, the narrow passages between the numerous rooms, we count 50, and the inaccessibility of the front complicate the site documentation stages.

The University of Florence and the Polytechnic of Valencia conducted a seminar with the students participations of the Survey Laboratory in February 2020.

Initially, the researchers counted on tackling the survey with the help of the laser scanner and integrating it with three-dimensional photogrammetry. Due to the breakage of the scanner and the imperative need to respect the times and dates of the seminar, the researchers had to tackle the work following the lines of a quick photographic survey integrated with the traditional manual trilateration method.

There are several binding factors in the survey:

- The time available for the acquisition and field verification of the acquired data;
- The impossibility of carrying out a closed polygonal and o topographical survey of the facade
- The simultaneity of the survey faced by four groups of operators.
- The succession of 50 rooms located on different levels and often connected by narrow passages, apparently the same until you know every single cm by heart.
- The environments are mainly passable only if the operators are folded, and therefore difficult to take photographs
- The inexperience of the participating students facing an archaeological survey experience in a challenging environment due to the narrow spaces and environmental factors.
- The front allows a photographic take without the influence of shadows only at certain hours of the day. The variability of the light that filters in streams into the internal compartments conditions the homogeneity of the sockets of the rooms.

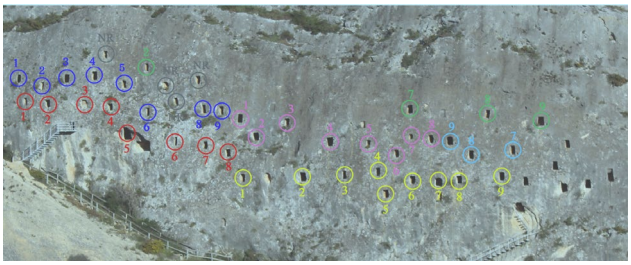

Figure 8. Subdivision of the rooms according to the corresponding openings to the outside. The different colors and numbers identify the detector in charge, the number of assigned rooms, and their sequence.

Once the inspection was carried out, the strategy of the documentation project was developed as to how to integrate the manual survey with the photographic one.[6]

We have catalogued each environment concerning the openings in the external vertical wall (Fig.8). At the edges of the windows, we placed mire, which could relate the external front to the internal one; they were of different colours, assigned to the student operator, and numbered according to the correspondence of the interior compartment. The sights corresponding in number and colour to the external window were positioned in these.

Inside each room, with the help of an ordinary laser level, a horizontal plane was traced, and the variation in the height of the floors between the contiguous ones was measured.

On the same section line, we took the trilateration necessary to control the adjacent rooms' deformations and trends, where this was possible. For each room, a height was taken, the distance from a point marked on the ceiling to its projection on the ground, both related to the horizontal profile. The data collected, returned and georeferenced to the CAD later allowed to assign the coordinates of the marker points identified in the photos and to scale and orient the drawings in the elaboration software Metashape PRO.

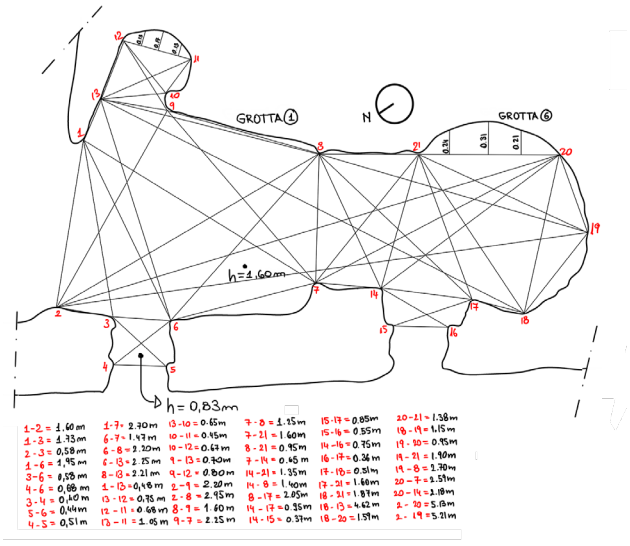

Figure 9. Eidotype. Taking traditional metric data.

[6] Integrating the manual survey with photogrammetric processes had already been tested in the survey campaign to document some Gasr in Libya in 2009 and some rupestrian buildings in Cappadocia in 2010. (Crescenzi 2012)

Figure 10. Covetos de los Moros. Bocairente. The different floors Plan of the settlement.

3.2 Photographic data

The photographic survey was carried out with the cameras of several manufacturers[7]. The exterior vertical wall is challenging to see and read; it stands on the escarpment of the riverbed, and the only possibility to see it is from the opposite stand.
Therefore, not having an Unmanned Aerial Vehicle available, the intake stations for documenting the façade were chosen on the valley opposite side onto which the site overlooks. For each station, the photographic survey was carried out with different focal points to obtain elaborations with a definition suitable for the various readings of the elevation and the details that characterize the facade.
A 70 cm square was displayed at one of the windows to have a scale reference for the front (Fig.1). A further scale comparison was possible after realizing the interiors, from which we took some reasonable distances after aggregating several units.

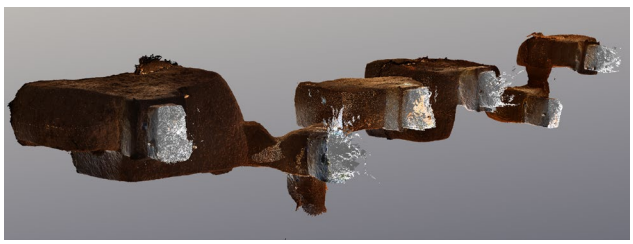

Figure 11. Covetos de los Moros. Bocairente. Merge a chunk of five rooms.

For the three-dimensional construction of the site, in data processing, many chunks were designed as building rooms. The grips of the sights located in the profiles of the openings between the rooms and on the opposite walls made it possible to join the rooms in sequence (Fig. 11). The articulations and small dimensions of the window compartments made data processing difficult.
The target placed on the external profiles of the windows, readable from inside and outside, made it possible to connect the exterior wall with the internal volumes. This was the most complex step due to the different lighting and the few possible sockets that allow elaborating a sufficient overlap between the internal and external surfaces.
The quality of the data, compact dense cloud and texture (Fig. 12), is given by the number of photos sufficient to model the roughness of the surfaces, their free movement, and the furnishings collections.
Data processing followed the procedural practice, supported by a careful choice of photos. The quality of their yield was checked every evening at the end of the work; the failed surfaces were re-detected.

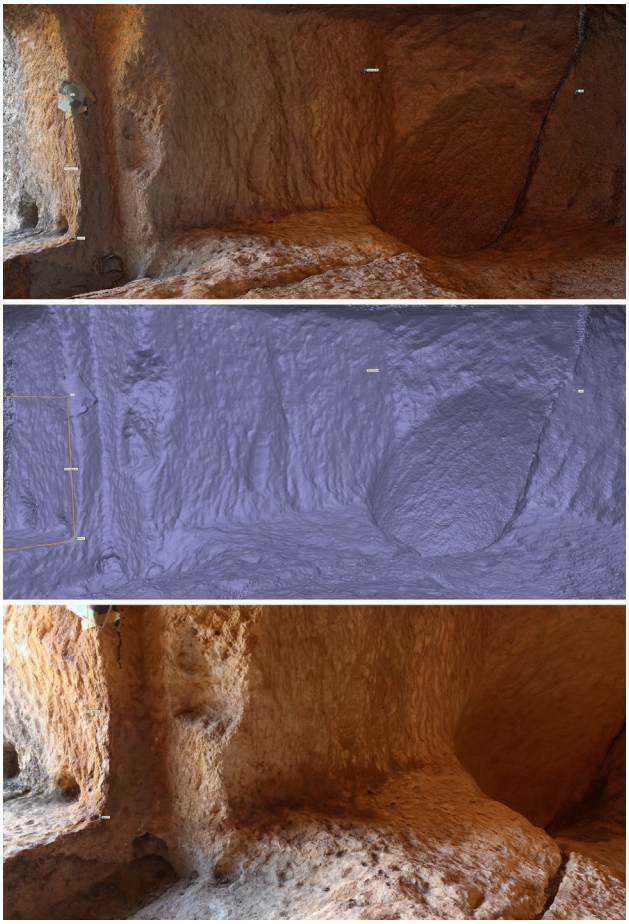

Figure 12. Covetos de los Moros. Bocairente. The 3 green cave. Detail of dense cloud, mesh and texture.

4. RESULTS AND AIMS

The results are of good quality and allow the reading of the individual rooms and the working on the rock, engraved and written signs, allocations, and attachments for closing the openings, and other valuable tracks.
The three-dimensional images are suitable for reading the individual rooms in their entirety and continuously for confirming or suggesting an interpretation of the architecture. In addition to the orthogonal projections of the side walls of the plan and the ceiling, axonometric and perspective drawings have been created for more immediate communication and reading for non-experts.
Each environment has been numbered and catalogued according to its opening on the vertical front. The traditional relief constituted the support network for the aggregation and orientation of the individual rooms. The expeditious survey based on terrestrial photogrammetry and portable systems has increasingly proved to be essential as a key tool for digitising cultural heritage sites.
It is even more essential in less renowned heritage contexts with complex accessibility, especially with limited technological support and low-budget surveys. Learning an accurate approach

[7] In particular, the shots were taken with Nikon D 5100 wide 4928 x h3264 and Nikon D 3200, D3400 and D5600 with a definition 6000 x 4000 as well as a Kanon EOS 600 D 5184x3456;

to traditional analogue surveys integrated with new 3D photogrammetry for heritage documentation is necessary to increase cultural heritage documentation.

Figure 13. Covetos de los Moros. Bocairente. The 8-9 blue caves.

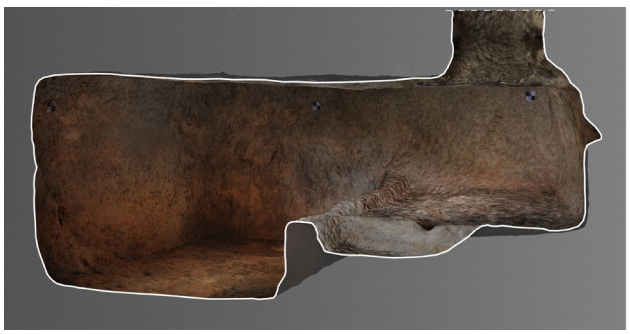

Figure 14. Covetos de los Moros. Bocairente. The 8-9 blue caves. Perspective.

Rock architecture and its landscapes are at risk, and their decay rapidly increases.
The development of a simple control way to scale and control the models' deformations is vital.
It is necessary to integrate and optimize the metric data from different origins, into 3D models, to offer strong support for archaeological investigations, and also for the enhancement and promotion of the heritage and the territory. The models thus created, can facilitate on-site work and remote activities.

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Image credits.
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