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Reflections on workflow and standards for the graphic survey of architectural and archaeological heritage

During the first decade of the millennium, a slow evolution in the digitalisation of architectural surveying took place. The qualities achieved at first were difficult to compete with analogue systems, so they had to mature until being definitively established. In any case, it was technological development in the following decade that brought about a true revolution in digitisation. Thus, it was during the last ten - twelve years that we have witnessed a true revolution in the methods used within the three-dimensional graphic survey of architectural and archaeological heritage. The incorporation of multi-image photogrammetry (SfM, Structure from Motion) and the new 3D laser scanners broke through in a rather short period of time, allowing us to speak about the advent of a new paradigm. All of this has not only favoured the obtaining of hyper-realistic three-dimensional models, but also the popularisation of such methods due to their extreme simplicity, economy and the visual appeal of their outcomes. In consequence, we can state that these technological advances have triggered a genuine revolution in the documentation of architectural and archaeological heritage.
However, if one looks back, very few attempts have been made to provide standards for heritage documentation, thus showing that the success of previous attempts to establish standards for graphic surveying in different areas has not been as effective as could have been expected. This was mainly due to the obsolescence of these standards and their lack of updating, as they were not able to keep up with the speed of evolution of the applied technologies. Nevertheless, we observe that the obsolescence problems are due, in most cases, to the fact that these specifications and standards emerged at the beginning of the last decade (2010), when we still had a significant room

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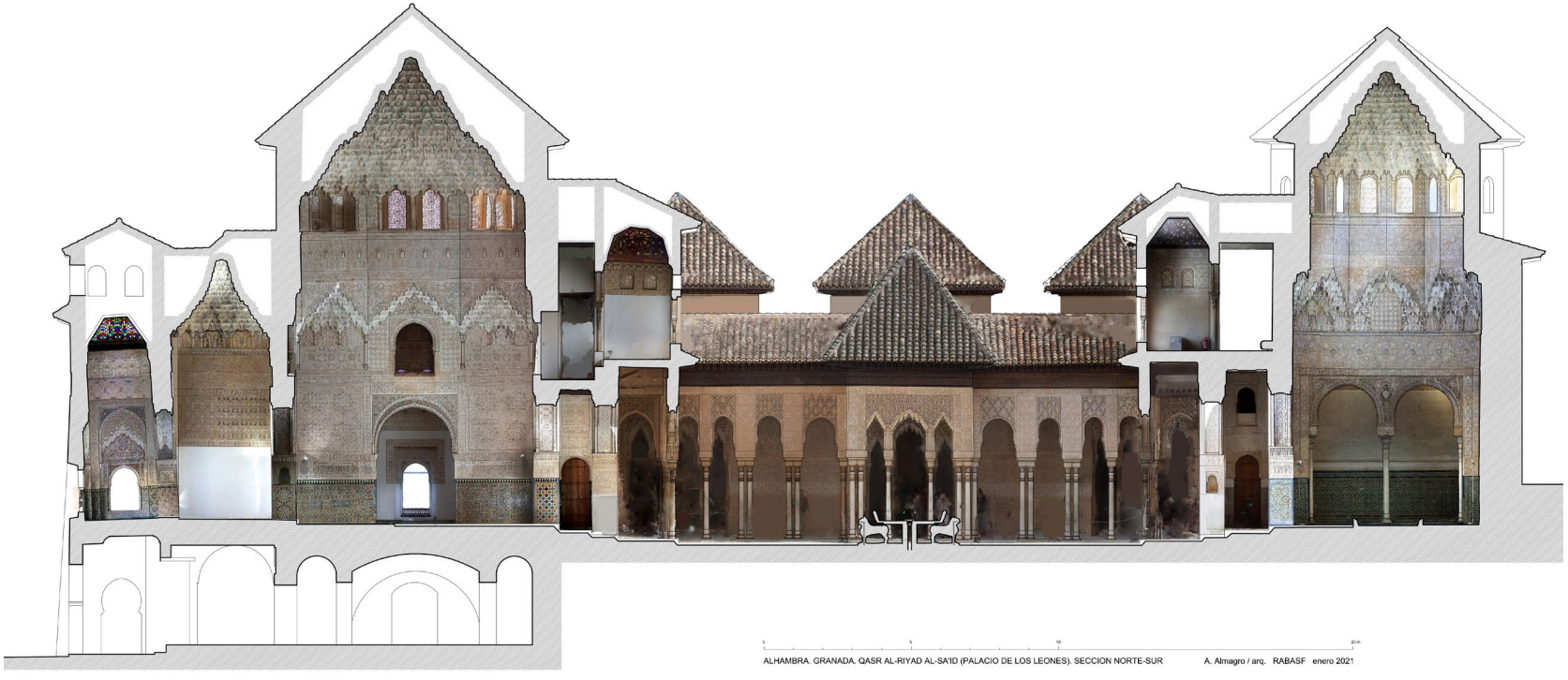

Fig. 1 - Section with ortophoto of the *Palacio de los Leones*, Alhambra of Granada (Spain) (Antonio Almagro Gorbea).

for improvement. Today, we may think that the techniques are reasonably mature, and although advances will certainly be made, those would no longer affect the quality control systems of the processes, which are the ones determining the suitability of the final product, which is nothing other than the documentation of the heritage. To give an example, the resolutions of photographic sensors may continue to increase, but our own eyesight is no longer able to discern this improvement. Hence, in many cases the technological capacity exceeds the capacities of the equipment, and even so, the product obtained may not be of the expected quality. In other words, the technological paradigm is solved, while the processes and quality parameters required at each stage are not.

Nevertheless, although the use of this digital technology is nowadays widespread, there is a need to highlight and share certain aspects little dealt with or unresolved, in order to properly exploit its potential. For this reason, this new issue of DISEGNARECON has been launched, which was intended to deepen the express specification of the methodologies applied or applicable to these graphic survey methods, mainly in accordance with two factors: the different scenarios (case) and the objectives to be achieved

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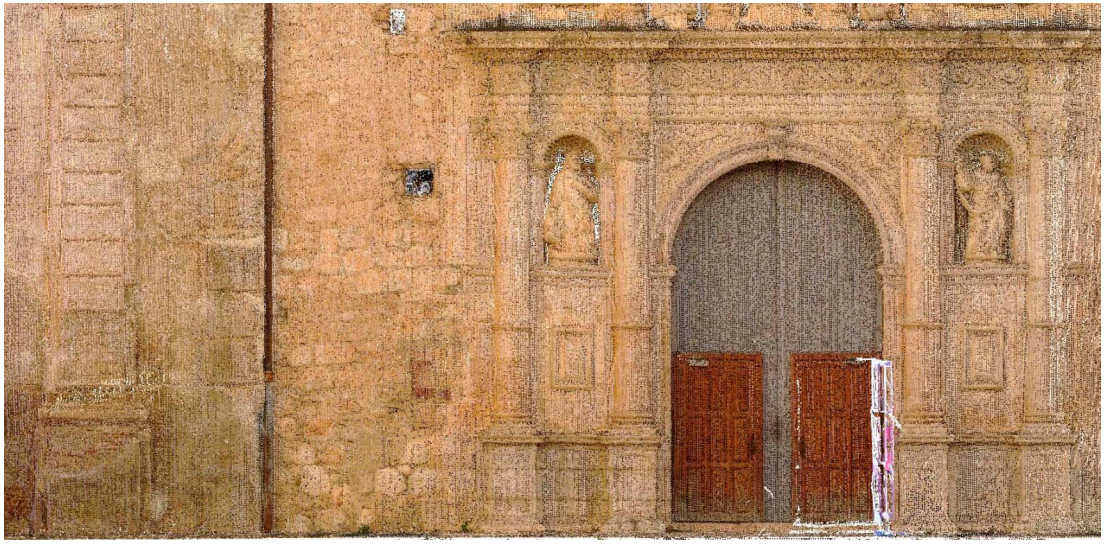

Fig. 2 - Façade of the Basilica of San Jaime Apóstol (Algemesí, Valencia, Spain). Point cloud obtained using the Faro Focus 3D laser scanner. The point cloud has been taken appropriately, with a number of clouds enough to cover the whole element, and in low density mode. When the aim of this survey is to obtain a three-dimensional model for visualisation on mobile devices (tablet or smartphone), the used standard is correct. Nevertheless, if the purpose of this data collection is to draw up the plans prior to the restoration, needing to draw all the elements involved, the standard used is incorrect, as the mm/pix resolution needs to be increased in order to be able to carry out the drawing (authorless).

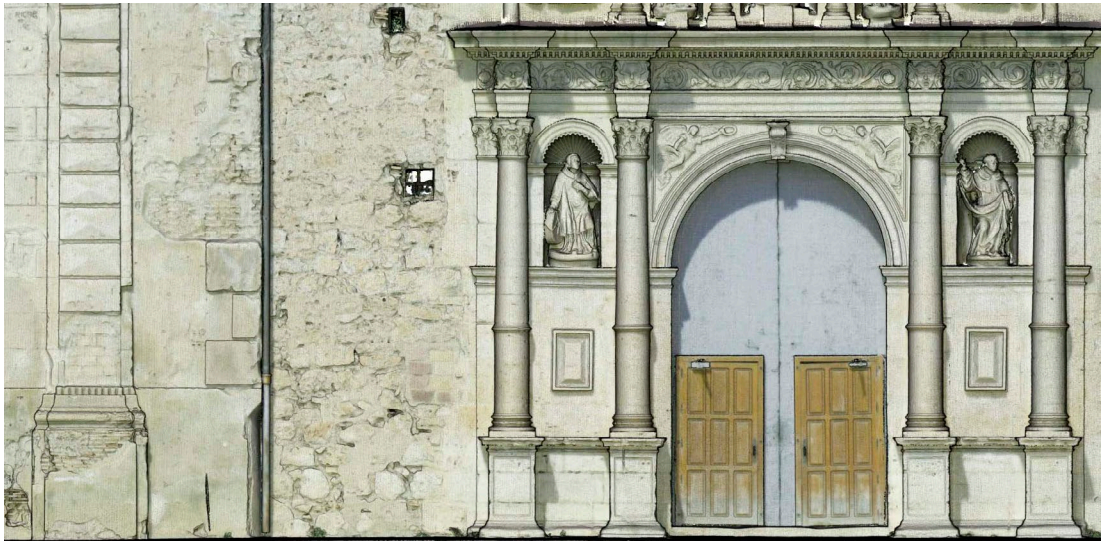

Fig. 3 - Façade of the Basilica of San Jaime Apóstol (Algemesí, Valencia, Spain). Point cloud obtained using a Leica RTC360 laser scanner. The point cloud has been properly taken, with enough clouds to cover the whole element, and in high density mode. In this case, the aim was to draw up the plans prior to restoration, having to define all the elements that make it up. We can see that the used standard is correct, as the mm/pix resolution was enough to carry out the drawing (Teresa Gil-Piqueras, Pablo Rodríguez-Navarro, Anna Pérez Vila).

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(use). We are clearly talking about workflows and minimum standards required, so we can deal with many aspects of vital importance in architectural and archaeological heritage surveys, both in the field work stage (data capture), and in the office work (information processing), or in the management of the obtained information (management for the target user).
Given the methodological differences, mainly caused by the wide range of technological possibilities in terms of both tools and software, it becomes necessary to deepen, systematise and optimise the plethora of different workflows in use. That is the only way to make our work properly profitable, while guaranteeing the achievement of the required standards.
We can state that the required standards must define our graphic survey; likewise, they are essential in order to choose the suitable workflow, proper tools and the required software. But to do this we should start by identifying the necessary factors in order to know which is the standard in each case: these factors will be precision, resolution, plot scale, digital approximation, format, storage,...
The call for papers in the present issue of the journal is directly related to its editors' work on the national research project entitled "Integral 3D graphical survey of heritage. Optimisation of workflows and proposal of standards. 3D4HERITAGE" (R+D+i Retos 2020. Ref. PID2020-119469RB-I00. Ministry of Science and Innovation. Spanish Government). The relevance and usefulness of the topic can be seen clearly in the high quality and quantity of proposals received, which after being selected and reviewed by the scientific committee and collaborators experts in the field, led us to one of the journal's issues with the highest number of accepted papers.

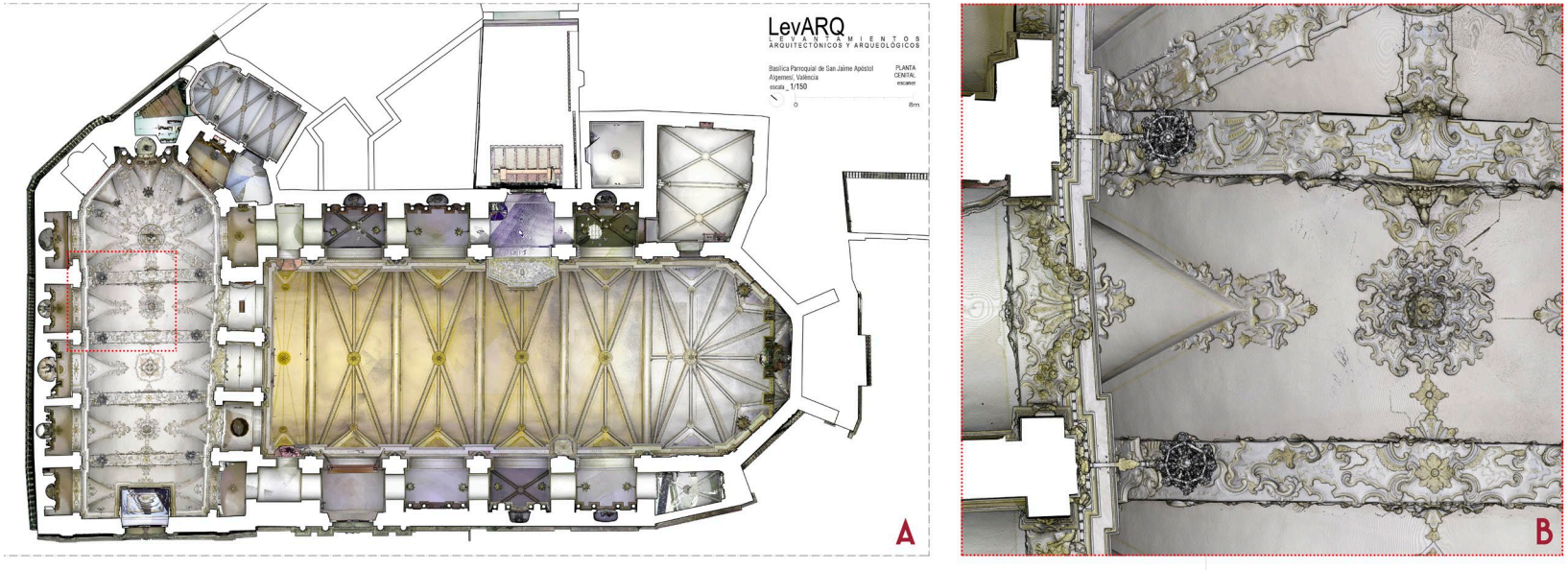

Fig. 4 - (a) Zenithal view of the Basilica of San Jaime Apóstol (Algemesí, Valencia, Spain). Point cloud obtained by laser scanner Leica RTC360. (b) Detail. It can be seen how a high density of the different clouds, together with a computed number of clouds, allows us to obtain orthophotos of the cloud, in this case with a resolution of 2 mm / pixel, giving an appropriate visualisation of the line drawing (Teresa Gil-Piqueras, Pablo Rodríguez-Navarro, Anna Pérez Vila).

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Fig. 5 - Roman Villa of Sant Gregori (Burriana, Castellón, Spain). Ground plan orthophotograph of the archaeological site obtained at a resolution of 5 mm/pix taken for the excavation monitoring. The flight height has been affected by this resolution, the viewing angle of the lens and the sensor's pixel size. In this case, the take was carried out using a Dronetools quadcopter drone, mounting a Sony R100II camera (Pablo Rodríguez-Navarro).

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Fig. 6 - West elevation of the gothic cloister of the Palace of the Generalitat Valenciana (Valencia, Spain). Orthophoto obtained using a drone for the production of a tarp to cover the scaffolding for its surface cleaning. In this case the resolution is affected by the plotter which prints the tarp, working at a resolution of 100 dpi (Pablo Rodríguez-Navarro, Pedro Cabezos Bernal).

These papers mainly deal with case studies, with an emphasis on new methodological proposals, showing us proposals and results of a specific workflow. We can also find proposals of protocols for the documentation and archiving of case studies and specific themes, such as the case of the Atlas of Almohad Architecture presented by Antonio Almagro. No shortage of methodological proposals on the use of HBIM, Scan to BIM, video for SfM, patological analysis, GIS, virtual reconstruction, augmented reality, etc. Outstanding in the field of the determination of standards stands out the article presented by Joaquín Aguilar-Camacho, Gabriel Granado-Castro and José Antonio Barrera Vera, taking the Real Alcázar of Seville as a case study.
The issue also features Marina Sender's interview to the architect Ramón Esteve. Marina Sender is currently Director of the Department of Architectural Graphic Expression at the Universitat Politècnica de Valencia (Spain) and President of the Official Architect's Order of Valencia, joining the academic dimension of graphic language with the professional reality, in an interesting and necessary university-society bond. The interviewee, Ramón Esteve, is part of that short list of prestigious architects with undeniable international recognition. The interview is directed, as one would expect, towards the graphic language, showing images ranging from the initial creative sketches to the finished work itself.

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Figg. 7,8 - Layout and detail of the tower of Alcudia de Veo Castle (Alcudia de Veo, Castellón, Valencia). Layout obtained from the 3D photogrammetric model. The flight was carried out with a DJI Mavic 3E drone +RTK, with the aim of obtaining the scaled graphic documentation. The layout is in 1/200, so the required resolution for printing at 300 dpi was 17 mm/pix, and the tower in 1/50, and the required resolution for printing at 300 dpi was 4.3 mm/pix (Pablo Rodríguez-Navarro, Teresa Gil-Piqueras, Anna Pérez Vila).

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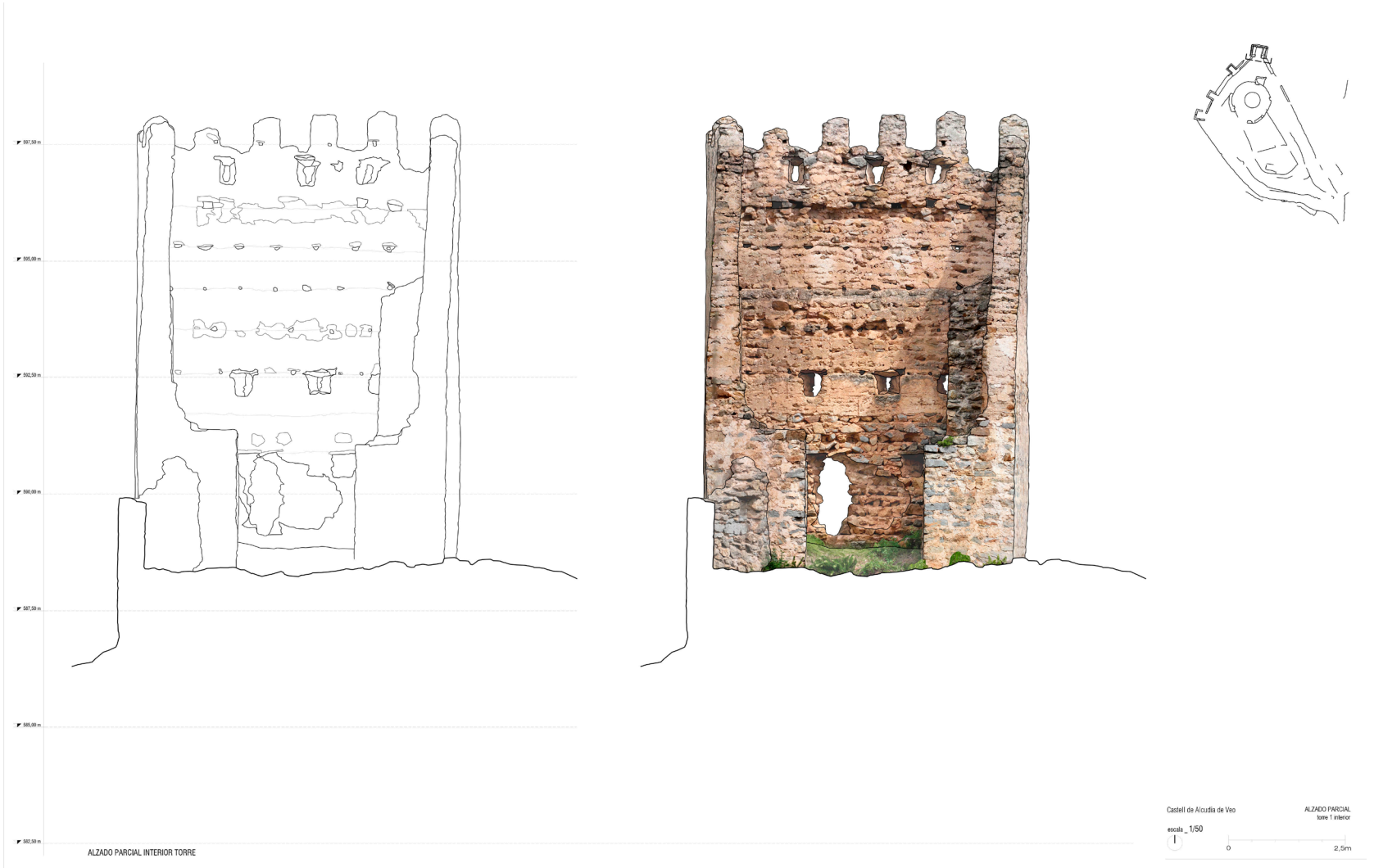

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Fig. 9 – Front view and detail of the coat of arm of Duque del Infantado (Mendoza's familly). found on a portal of *El Arca del Agua* (El Sotillo, Guadalajara). The photogrammetric take was carried out using a Sony a7r camera. As the aim was to documenting and analysing the inscriptions, in this case the required resolution will be very high in terms of mm/px and of quality, as the image contrast will affect the possibility of interpretation of such inscriptions (Pablo Rodríguez-Navarro, Teresa Gil-Piqueras, Andrea Ruggieri).

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