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BETWEEN LANDSCAPE AND ARCHITECTURE: ENVISIONING CAPPADOCIAN RUPESTRIAN MONASTERY THROUGH COLORFUL CONTOUR LINES

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Abstract:

Architectural heritage preservation bases on a deep, layered and interdisciplinary knowledge of the sites, especially when they are on the edge between natural and artificial, like rupestrian architecture often is. Survey and representation of rock-cut architecture are between the most problematic issues for a number of problems concerning the geometrical complexity of the interior and exterior enveloping surfaces. Laser-scanner is an appropriate tool concerning the registration of geometric and spatial properties of those artificial caves in continuity with the external topography, but automatic representations are often unable to convey their hidden geometric and spatial relationships. In the context of a work methodology customized on the rupestrian habitat of Cappadocia, the authors developed an original envisioning model in which an associate use of contour lines and chromatic codes transforms traditional orthogonal projections after the numeric model into drawings able to offer a synthesis and transmit the complex forms and relationships of rupestrian settlements.

Key words: Cappadocia, Karanlik Monastery, Rock-cut architecture, Cultural Heritage, Infographic representation

1. Introduction

In the traditional practice of architecture survey, after a first phase of acquisition of the basic measures, a geometrical model is built, first mentally and then either graphically or digitally. This model represents the architectural subject through elementary geometric elements, such as parallelepipeds, cylinders, and spheres, which approximate the actual parts of the building. This geometrical model can be sectioned and projected in order to obtain plans, elevations and sections in an appropriate reduction scale and according to a metric tolerance that is proportional to the scale adopted. The introduction of laser scanning and digital photogrammetry (Briese and Pfeifer 2007) has changed this process, which was cognitive and representational at the same time. The cloud of points generated by laser scanner procedure is the visual outcome of the process of measures acquisition. It reproduces the architectural body silhouette but despite the appearance of a defined numerical model (points model), it still requires a long processing stage to represent the morphological and chromatic features of the artefact in a consistent and univocal way to result in a scientific document of reality.

2. Rock-cut architecture in Cappadocia

The knowledge and preservation of architectural heritage are based on a deep, layered and interdisciplinary knowledge of the sites, especially when the architectural monuments are on the edge between natural and artificial as well as between archaeology and landscape, like rupestrian architecture often is. As a survey team of a national research, in the last years the authors have focused on the survey and representation of Cappadocia rock-cut architecture (Carpiceci 2013), also experimenting a work procedure to meet the needs of both metric precision and correctness of the final graphic outcomes. Rupestrian architecture has its constructive specificity in being cut out of natural rock formations: this means that interior space is realized by subtracting matter rather than adding and assembling parts. As a consequence of this way of producing space, there is no direct relationship between interior and exterior surfaces. The external look of a rupestrian church is made of the natural surface of a cliff while ancient builders shaped interiors by generally replicating rooms and forms after traditional architectures of the same ages, which can be easily reduced to their geometric models.

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3. Survey criteria

The three levels of rooms of the so-called Monastery of Karanlik (the Dark Church) in Goreme Open Air Museum (Fig. 1) have been surveyed thorugh a small and light laser scanner FARO Focus3D X130. Spherical target shapes have been extensively used during the recording of individual clouds. The external surfaces of Karanlik Monastery have been scanned at sunset while the internal surfaces of its rooms have been scanned in the dark of the night, for three consecutive days. This procedure responds to the problem of the crowd of tourists walking in this monument all day long. Surveying the painted surfaces within many of the rooms has required a special consideration (Carpiceci and Colonnese 2014; Carpiceci 2013, Carpiceci *et al.* 2015). With the existing artificial lighting, RGB scanner recording procedure produces bad pictures that do not record the chromatic data of the surfaces. A proper registration through high definition cameras and with a controlled uniform light on all of painted surfaces would have required too much time. An acceptable compromise has been found in recording a black and white cloud by the reflectance in a complete darkness.

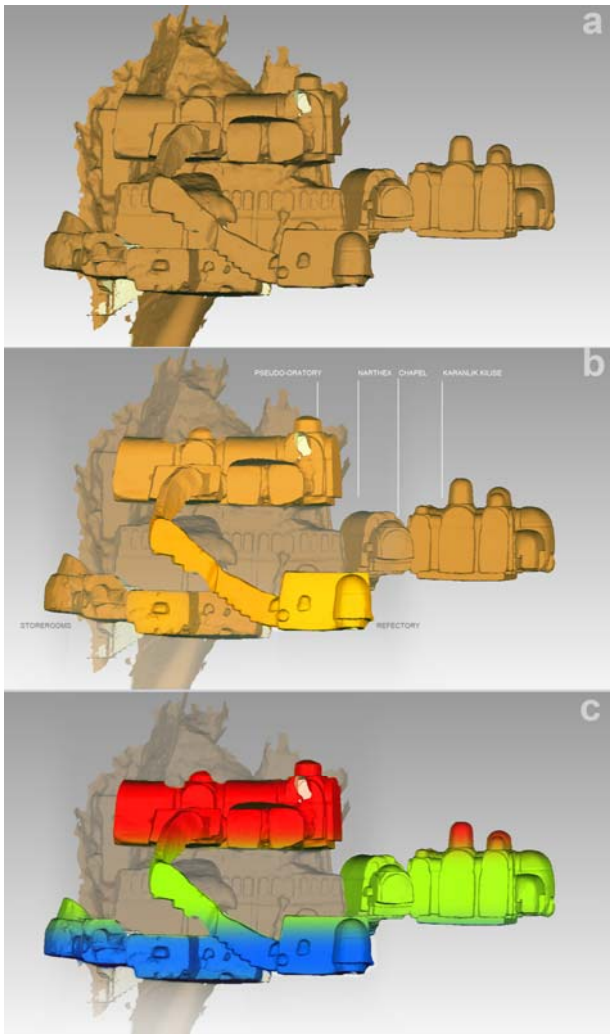

Figure 1: Meshed model after laser scanning, view from the east: a) Basic view of internal volums; b) Atmosphere treated view to enhance apparent deepness; c) Color treated view of main rooms related to the grouped contour-line representations. Karanlik Monastery

After the registration, the numerical model (per points) has been processed and translated into a meshed model (per surfaces). This model has been used to understand the organization of the interiors and decide the strategy of the following representations. The model of the interior volumes has been treated to optically enhance the deepness effect (Fig.1c), according to the principle of the atmospherical density or “prospettiva aerea” as defined by Leonardo da Vinci. However, this kind of images offers only a partial comprehension of the complex organization of the carved settlement.

4. Representation criteria

The sculptural nature of rock-cut architecture makes it impossible to envision rooms unambiguously through apparent contours or edges. Even advanced representations of rupestrian monuments after laser scanning are elaborated almost exclusively through photomapping and generally focus on internal spatial systems (Andaloro *et al.* 2013). Therefore, the authors opted for a contour line representation, like in topographic charts. This was also suggested by the morphological continuity between interiors and exteriors. A number of significant section plans have been identified according to their ability to describe the complex morphology of the settlement: horizontal for the plans and vertical plans for elevations and sections. In the cartographic practice, the equidistance (i.e. the constant gap between successive contour lines) is conventionally set at 1/1000 of the denominator of the scale of representation in meters. An equidistance of 5 cm is usually set for a canonical 1:50 architectural representation, but tests undertaken by the authors with this step have not given a readable result. The authors have consequently decided to adopt an equidistance of 10 cm that allows contour lines to describe the architectural shapes without becoming a sort of confusing background noise produced by excessive visual data. This envisioning model points out the relationships among the several rock-cut rooms and between them and the natural external surface of the rocky cliff. To make sense of the horizontal and vertical complexity of the whole settlement as well as the 3D relationships between the rooms, an experimental representation has been developed by multi-colored contour lines (Fig. 2).

The next step is the choice of the reference plans to produce the vertical sections. While a plan cannot but refer to a horizontal section plan, the vertical sections require a careful choice to describe most of the architectural characteristics of the rock-cut rooms whose configuration is so changing. In the case of Karanlik Monastery, authors have oriented the vertical sections in a perpendicular way to the longitudinal axes of the larger decorated rooms. By producing a number of sections driven by the position of the significant section plans adopted with regular intervals, this graphical strategy allows an efficient visualization of the tufa wall surfaces (Fig. 3).

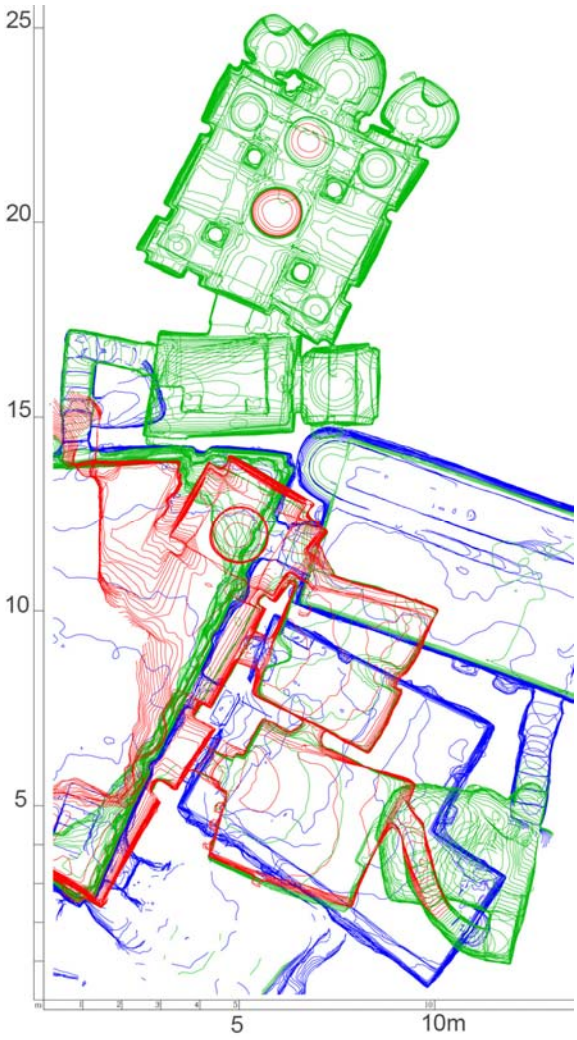

Figure 2: General plan, detail: lower level in blue; middle level in green; upper level in red. Karanlik Monastery

5. Conclusions

Until a few years ago, the drawings of Cappadocia rupestrian architecture were obtained with traditional procedures and showed plans and sections with rectangular rooms, definitely regularized if not invented. They were a direct representation of that geometrical model that every surveyor builds in his or her mind to study and gradually master an architecture configuration.

However, this sort of aggregation of parallelepipeds and cylinders should be only a stage of the process and not the final graphical result. The authors believe that a neutral and faithful representation of actual forms by contour lines can:

- describe the strong continuity between external natural surfaces and internal carved rooms;
- suggest meanings and intent beyond the cliché of the "rough imitation of traditional Byzantine architecture";
- cast a new light on constructive intents;
- emphasize the visual perceptive role of paths, openings and curved surfaces.

Moreover the use of polychromatic drawings to envision the relationships between distant rooms may contribute to form new hypothesis on both their uses and their transformation stages. For example, they are able to reveal unpredictable geometrical relationships between distant rooms, as in the case of the church and the rooms of monastery, despite the triangular shape of court and the rotated entry hall.

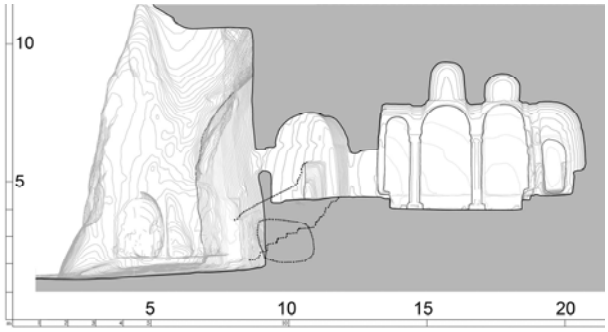

Figure 3: Longitudinal section per contour lines through the church. Karanlik Kilise.

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