From survey to representation. Operation guidelines

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Abstract

The study and analysis of archaelogical sites in the optics of surveying and representation has always been a subject particularly clear to develop and master. The complex nature of forms to be surveyed has often made the researcher struggle with technical and logistic problems inherent in the instruments used in the stage of data acquisition. True, these instruments guaranteed a high measuring confidence, yet – at the same time – demanded enormous expenditure of resourses and time both for acquiring and elaborating the data gathered. Fortunately, thanks to recent technological development, innovative instruments have appeared making it possible – through semi-automatic processes - to simplify the operations necessary for conducting surveys guaranteeing nevertheless a low level of uncertainty. The 3D laser scanner is of special interest in this regard because its technical features ascertained a new standard in the process of data collecting.

For a few years now the research conducted within the Department of the History of Architecture Design and Restauration has aimed at drawing up the so called *operative procedure* which concretises the methodology of surveying and representation of works of architecture that would make a full use of the new technologies and rigorously define both the techniques and the procedures of traditional survey.

This dynamic and ever evolving instrument has been developed and verified during many surveying campaigns which concerned works of various nature and complexity. It is important to emphasise that the idea of imposing a strict procedure is not meant to render the process of surveying mechanical. Rather, it has been conceived as offering aid and a critical point of reference to the surveyor who can thus optimize the process of surveying and choose more effectively the procedure compatible with what can be called the 'scale of the model' to be analysed and reproduced through different techniques. Ideas of this kind were born and developed also thanks to the collaboration of highly trained archaeologists who made us understand to the fullest extent possible the goals and expectations of each surveying campaign.

Among the numerous experiences on both national and international level, worthy of mention are some surveys which contributed to the defining of the procedures, obviously taking into account the unique features of the work surveyed.

On the territorial/urban level there were the outstanding surveys of some Roman theatres in important archaeological sites, such as the Roman theatres of Petra and Jarash in Jordania, the Roman theatre and amphithaetre of the town of Mérida in Spain or the Roman theatre in Taormina.

On the small scale, surveys of the Tempio di Claudio and of the Arco di Giano have been conducted for the purpose of studying architectural details. Moreover, there were numerous cases where the dimensions of the objects analysed were much more modest because the objective was to provide smaller details which then served to develop the prototype, and thereby the physical reproduction of the objects in question. (Fig.1).

Fig. 1 The archaeological complex at Merida, Spain. Visualization of a point cloud

The synergy between architects and archaeologists was absolutely indispensable in all these enterprises for the purpose of correctly interpreting the object under analysis, unifying correct procedures of data acquisition with the awareness and a deep knowledge of the object.

The Operative Procedure

The surveying procedure – intensive as a process of study aimed at a correct representation of the object analysed – consists substantially of two inevitable sequences: a 3D surveying, which makes the best possible use of various methodologies and instruments for data acquisition – on the one hand, and a 3D survey obtained by comparing different representative models – on the other.

The stage of 3D surveying is the procedure of data acquisition, be they metric, historical or cultural, which are characteristic of the object under analysis. Each piece of information that makes for a better understanding of the object is studied with the view to obtain a set of qualitative and quantitative data. Metric information is not acquired by taking advantage of a single methodology alone. On the contrary, experienced surveyors are able to integrate different modalities in order to take the best advantage of the potential inherent in each instrument. In this way the so called 3D integrated surveying is worked out by using topographic instruments, digital photography, long and short range scanners and photomodelling as well. Each of the methodologies provides a higher level of knowledge and a significant support for the stage of 2D and 3D restoration of the object. This initial – operative – stage might seem a simple technical-mechanical operation. It needs, however, much preparation as well as selecting an operative strategy to be applied, the latter being possible only on the basis of an intimate, integrated knowledge of all the existing relevant methodologies. It must be underlined that the knowledge of the instruments does not mean a simple familiarity with the way they work. It also requires an understanding of the modalities and the ability to manage the data obtained. When using a laser scanner, for example, it is imperative to know and elaborate an enormous numer of data which are usually acquired to describe best the object of analysis. At the same time one must have a proper theoretical and practical knowledge of informatics and – above all - the technical-theoretical skills to recognize and interpret architecture. 3D laser scanners cannot yet distinguish essential elements which describe an element of architecture. Their capacities are limited to simply gather a determined number of information per unit of surface area, i.e. they can only perform mechanical operations. Thus, understandably, the result obtained with the 3D laser scanner uninterpreted by an expert user, remains but a numerical model, a point of departure for further elaboration and never a final result. The different operations involved in the process of data collecting are studied and selected in the so called 'survey project' that determines their necessary number, position and instruments to be used. The following stage, that of 3D survey, comprises operations which render possible a transformation of objective data acquired through surveying into information necessary to achieve adequate elaborations by integrating models. Obviously, taken into account are two-dimensional (2D) models – like plans, projections and sections – and three dimensional (3D) ones, like details - static and dynamic.Taken together these representations make possible a complete interpretation of the object, enlarging the perception obtained through classical two dimensional elaborations thanks to experiences of the 'total immersion' type which

give us the opportunity to simulate the navigation around and inside the model. Moreover, taking advantage of 'rapid prototyping' it is possible to reproduce almost exactly the object under analysis by constructing a maquette of considerable communicative value. Understandably, the problems inherent in the scale of representation should by no means be neglected. They ought to be taken into consideration with all the models examined in order to avoid communication problems. As noted above, the models must be worked out by expert hands, with appropriate software but above all by persons of high sensibility and a deep knowledge of the material, for only they can make correct 'interpretative choices'. What was unreachable with traditional survey, i.e. the breaking up of the forms to be surveyed by selecting significant edges and axial symmetries, can now be transferred in the stage of restoration to the computer with such instruments as a 3D laser scanner. Nevertheless, each model type is controlled and regulated by the operative procedure which determines the various modalities of representation necessary for a correct communication of survey data. Two dimensional elaborations, for example, are obtained through geometrical representations that determine axial symmetries and proportioning of constitutive parts (Fig. 2).

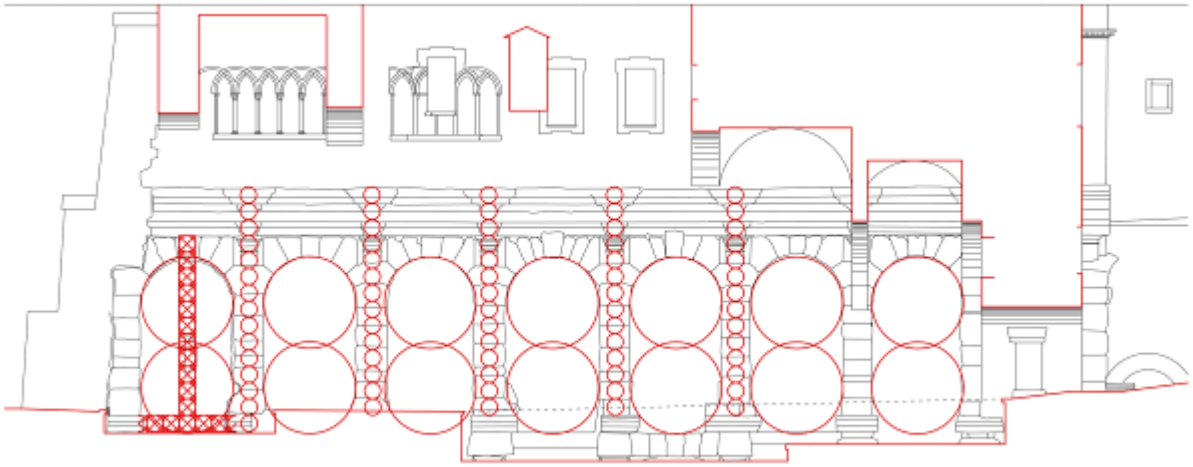

Fig. 2 Tempio di Claudio in Rome. Geometric longitudinal section. Inserted are schemes showing the proportions

They in turn provide indications - inherent in the relations between a part and the whole of measurment and of architectural representation - by marking surface areas in a way to guarantee an equivocal relation between the object and its model.
Three dimensional elaborations are also subject to codification which permits a passage from geometric representation to one significantly detailed and devoid of photographic texture. (Fig. 3).

Fig. 3 Arco di Giano in Rome. Three-dimensional model with and without the photographic texture

The final product of the surveying process seems to be, therefore, a virtualization of the real object under analysis. It is represented through a series of models that can describe each part of the object in pre-established scales and thus preserve the object of study virtually as a collection of data, presenting it as an objective datum for comparison in the future.

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Year ***2012***

Publication Name	***Computational Modelling of Objects Represented in Images III Fundamentals, Methods and Applications Edited by João Manuel R . S . Tavares***
Printer	***CRC Press 2013***
Type of Publication	**Article in book**
Keywords	**Laser scanning, Architecture, Survey**
Pages	**459-463**
ISBN / ISSN	**978-0-415-62134-2**
eBook ISBN:	**978-0-203-07537-1**
DOI:	**10.1201/b12753-84**