

THE INTEGRATED SURVEY FOR THE KNOWLEDGE AND THE DOCUMENTATION OF THE ARCHAEOLOGICAL HERITAGE: THE “VILLA DEI MISTERI” IN POMPEI.

M. Canciani^a, D. Maestri^a, G. Spadafora^a

^a Dipsa, Università degli Studi Roma Tre, Piazza della Repubblica 10, 00185 Roma, Italy – (mcancian, maestri, g.spadafora)@uniroma3.it

KEY WORDS: Photogrammetry, Archaeology, Surveying, Integration, Interoperability, Representation

ABSTRACT

This work represents experimental results of a survey method based on integration of traditional and computer methods. This specific method so called “integrated survey”, constitutes an alternative to those used distinguished, because it uses different procedures applying them in function of the morphological specifications of the various parts of the architectonic organism. In consideration of this, it is necessary, starting from a first phase, to define a measurement project, which uses different methods and necessities, according to an outline which organises the different operations to be carried out on the spot in function of the different architectonic elements.

These can be divided in three groups differentiated according to the morphology, to which the different surveys methods correspond: the first group comprises simple geometric elements for which photogrammetric survey has been used; the second group includes more simple rooms which can be surveyed directly with a topographic station; and finally the third group constituted by constructive detail elements which are analyzed through traditional methods and instruments.

1. INTRODUCTION

Objectives of this research are pointed to experiment an expeditious and effective method of architectural and archaeological survey, which supplements the use of several methodologies and instrumentation, and to the editing of clear and effective graphic results.

The graphic restitution, realised through CAD software, characterised by the absence of repetitive textures describing the various building typologies, therefore, returns intelligible and reliable images of the constructive and formal features of the surveyed architecture. The group of work started this type of research already time ago, applying this integrated survey procedure both in archaeological field and in architectural and urban fields (Maestri, Canciani, Spadafora, 2001, Spadafora, 2006, Canciani, 2007).

1.1 The methods of survey for the archaeology (G.S).

It is a common and shared opinion that the survey is a check tool of the data emerging from the studies on historical, literary

and epigraphic sources. At the same time it also constitutes an excellent source of advice and research starting points.

In archaeological structures, survey problems are very different from those of structures which appear intact. The absence of sharp corners, the presence of out of plumb masonries or thick plaster layers only in some sections of the walls, impose a more complex meditation rather than a matter of simple measurement.

In such work conditions, the contextual use of two different survey methodologies has already been tested: traditional and instrumental (topographical and photogrammetric).

The instrumental survey allows to define a general model of the architectural complex and to identify a reference grid on which the data emerging from the direct survey can be placed. Thus it is possible to define horizontal and vertical sections, from the first survey phase.

In archaeological survey it is important to integrate several survey methodologies because the nature itself of the ancient structures requires a scrupulous analysis of the quarry face masonries, of the plaster’s fragments and of the floorings.

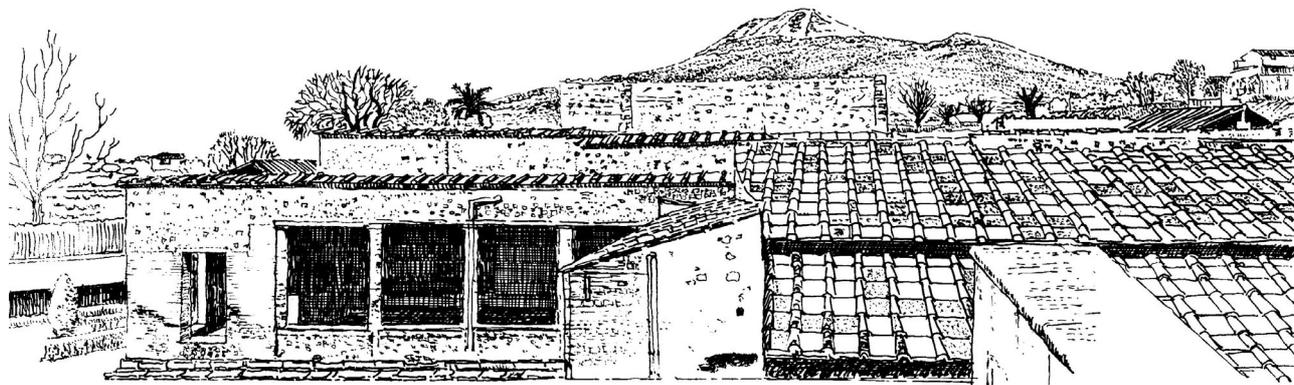


Figure 1. Villa dei Misteri view of South arcade (drawing by D. Maestri).

All these elements, assembled in a synoptic view, allow us to know in depth the consistence of the building and then to assume the main constructive phases.

Therefore, it is clear that the integration of the data emerged from both surveys, instrumental and direct, ensures a high level of accuracy.

2. INTEGRATED SURVEY PROCEDURES DIRECTED TO THE EDITING OF GRAPHIC ELABORATION (M.C.)

Integrated survey, making use of various methodologies of great importance, can be fitted to the various morphological features of the elements which constitute an architectural or archaeological object, providing a ductile and effective tool.

This system, in fact, constitutes the indispensable presupposition to obtain a survey which is expeditious and at the same time, careful, especially in surveying ancient structures, partially preserved, where it is necessary to obtain a description as much as more faithful of the elements which constitute the specific handmade (building structures, frescoed walls, mosaic pavements and lithic elements).

Such elements, based on their morphological features, can be distinguished in three groups, on which are applied as many survey typologies.

- The *first group* includes simple geometrical object such as frescoed walls, rotation surfaces (columns), spin surfaces (mouldings and vaults), coons surfaces (vault link). For this element typology we used a photogrammetric survey, realized by a minimum of four photographic shoots for the return of the various elements, and a polygonal net obtained by a topographic survey for space orientation of the elements themselves.

- The *second group* includes simple rooms which can be surveyed directly with a total station.

- The *third group* is formed by detail constructive elements, which can be surveyed with traditional methodologies and tools, with which it is possible to define exactly formal and dimensional features.

Data acquisition procedures take care, besides peculiarity of the object, also of the typology and features of the graphic results to be produced. Either a *horizontal section* or a *vertical section*, the analysed elements are distinguished in two categories, with reference to their geometrical features and to the adopted survey

procedure: a first, to which the intercepted elements of a section plane (section parts), and a second relative to elements in projection (projected parts).

Concerning the first elements (*section parts*), the survey is done directly on site, on positioning the topographic station in correspondence of the reference section plane.

The procedure uses a Pc connection to the topographic instrument (total station) through a specific software which allows to acquire the measured points in Cad ambient (AutoCAD) and then to position certain geometric elements referring to these points so as to define a *unique model of reference*. For each room interested by the section plane, likewise stations are positioned, referred between them by the polygonal of reference, of which it is possible to define the various portions of the section itself. The definitive section plan is completed through a direct survey of those parts which aren't directly visible by the stations and is integrated by detail outlines referred to architectural particulars, such as mouldings, columns, ledges, mosaics, etc...

As regards to elements of second category (*projected parts*), survey proceeds through a first phase of topographical measurements of certain characteristic points (so called *control points*), visible through appropriate markers and positioned on the walls and on the floors and by photographic shoots of the analysed elements. A second phase, differed respect to the first, with which a photogram metric restitution is effected. Such points, disposed in their effective collocation in the model of reference, allow defining rapidly the position of the various shootings (orienting phase of the photogram metric model), necessary for the restitution of the measured elements.

It is important to notice how, in the photogrammetric process it is possible to give back, not only points but also geometric entities such as guidelines, edges, curves, and surfaces of different kinds, which will be then used on graphic editing of the elaboration, and the relation between the measured points and those returned is in order of 1 to 300.

In this way, the various models of restitution, related to the structures in projection of the different rooms, are reported to a general coordinates system, so that a three-dimensional unique model is defined, composed by the sectioned parts, by those in projection and by certain points that which allow the positioning of the constructive details, directly surveyed. Such points, together with those visualized through markers, allow to switch

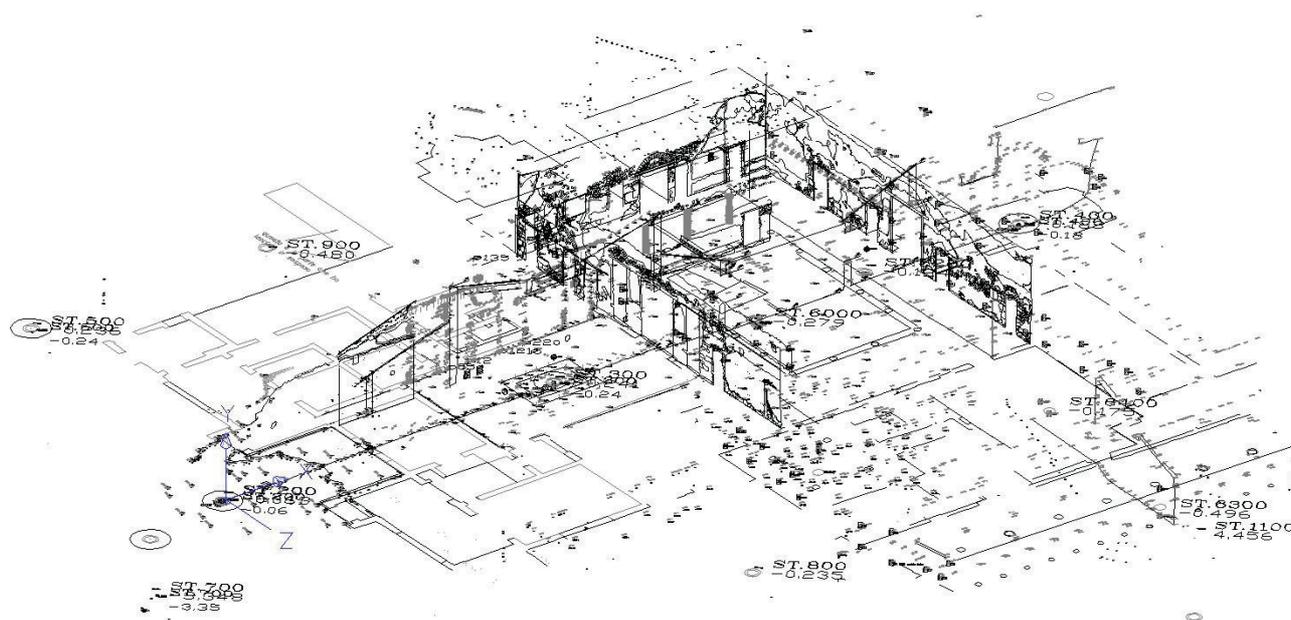


Figure 2. *Unique model of reference*, in which the photogrammetric restitutions of the single rooms are inserted.

After positioning the internal station, referred to the polygonal support net, measurements have been realized through the total station, as described in the paragraph n.2.

So it has been possible to realize a horizontal section (up to about a meter) which also considered the plaster fragments.

By a direct survey, it has been possible to complete the plan with the drawing of the masonries beneath the section plan.

The coordination of the survey operations has also allowed to reduce the processing times in CAD environment, when the model of the villa has been enriched with details.

The direct observation allows to locate more easily the presence of plugging inside a masonry, of superimposed plasters or structure doublings, all elements which complete the definition of the building transformations.

Also for the floors, the choice to work with integrated survey methodologies was greatly important in order to attain the prearranged aims: in many rooms, in fact, the floors were deformed by several subsidences and in few cases it has been necessary to distinguish, in the final drawing, the restoration parts from the original ones.

4.1 The survey of the details (G.S).

Once the plan was defined in its geometrical and formal aspects, we passed to the survey of the sills and several details, which complete the general drawing. Even though the final drawing to be produced was on scale 1:50, we considered as indispensable to proceed to the survey of many parts on full-scale. In this way, not only we obtained enhanced control in the survey phase, but also a final drawing rich of information.

With this aim, we surveyed the existent sills in various rooms, in some of which the hinges are still visible, and all the pieces of the gutter which turns around the building.

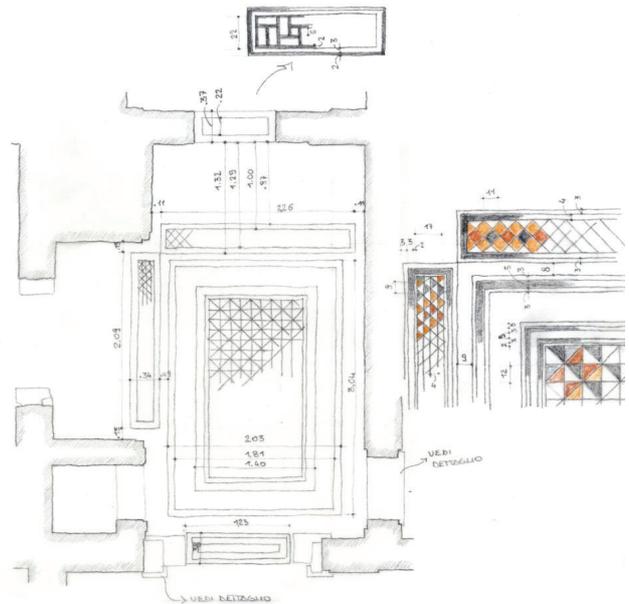


Figure 5. Eidotype related to the direct survey of the mosaics of the room 4.

4.2 The plans drawing (G.S).

The topic of the drawing of what has been surveyed is not at all insignificant: the task to synthesize all the work in few and consistent signs (which gives idea not only of the dimensions but also of the conservation of the monument) is just assigned to the drawing. For these reasons it was decided to avoid using the "hatches libraries" to describe the elements in projection. It was

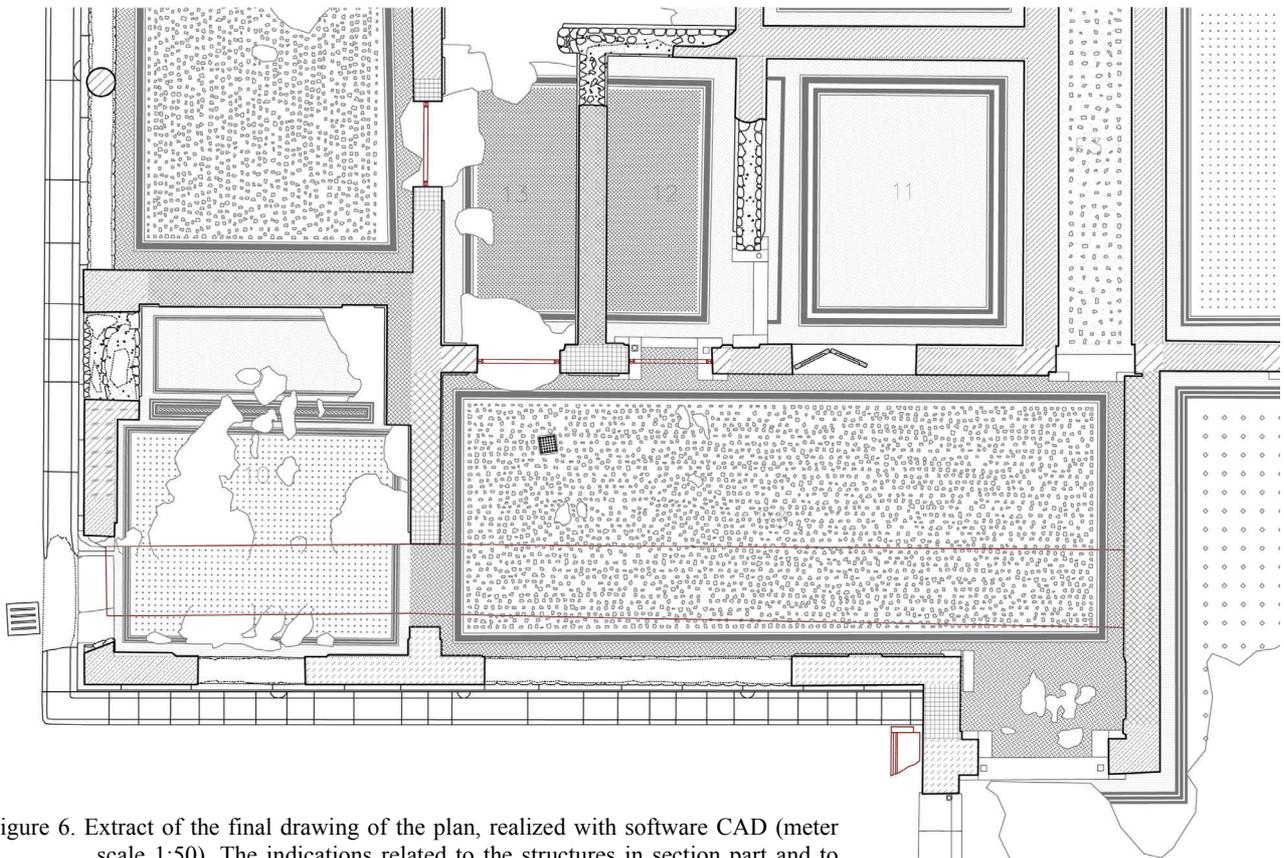


Figure 6. Extract of the final drawing of the plan, realized with software CAD (meter scale 1:50). The indications related to the structures in section part and to those in projection, the pavements and the sill, are drawn s.

also chosen to redraft the textures of some lithic elements which, even unreal, avoid a disturbing sequential repetitiveness. In order to describe sectioned masonries it was established to mark the plaster thickness with a dot line, to display the real thickness of the bearing structures; some pre-defined hatches, adopted by the Soprintendenza Archeologica di Pompei, were also used to obtain a graphic result in which the various building work typologies were readable. Through the direct survey, the drawing has been integrated, in projection, with the plaster in existence beneath the section plan. Through direct observation it was possible to find some doors or windows which had been plugged in the long run. This occurrence has been displayed with a hidden line.

In this way, also the ancient consolidation interventions result readable, marked with irregular punctate lines, and the recent restoration interventions are also identified.

In the plan drawing, therefore, elements in projection have been redrafted on the basis of eidotypes realized directly and using photogrammetry.

In particular, this last method was very useful to suppose the original drawing of the mosaic floor, adulterated by the background deformation. The reduced dimension of the cubicle 10 made more complex the photographic shooting necessary for the photogrammetric restitution. Nonetheless, thanks to the integration of the data obtained by the direct survey, it has been possible to arrive to a complete mosaic drawing.

The floor in *opus sectile* of the room n. 5 ("Mystery room") was measured by direct survey. The floors in flake concrete were surveyed by some detailed zenithal photos, which provided the proportions of the main elements constituting the general drawing.

5. THE INTEGRATED SURVEY DEFINING A VERTICAL SECTION (M.C.)

The process for the definition of the vertical sections, so as it has been theorized previously, goes on necessarily by definition of a reference model within which are placed a few control points. Therefore it is necessary to carry out some procedures, that can be synthesized as: the topographic survey of the elements in the section parts, by a station of the reference polygonal net, acquired directly by a pc notebook, transferring

measurements in software CAD; the topographic survey of some revealing points, placed on the walls, signalized by affixed markers, useful to photogrammetric reproduction of the projected parts; the photographic acquisition and the reproduction of the photogrammetric models; the direct survey finalized to the stratigraphic interpretation of masonries for the verification of the data acquired by the computer instrumentations; the graphical reproduction through integration of all the acquired data.

In the final phase of unique model definition, it makes a projection of the same model from the 3d coordinates system to 2d one is performed in new local references (so said in autocad: u.c.s.), relative to the section. While the section elements are already place in the coordinates of the reference plane, the external elements must be projected by perpendicular direction on the same plane.

In the specific survey of the Villa dei Misteri, four vertical sections and three elevations have been realized, that use the integrated survey method. For instance in the elaboration of section East-West, towards North, and passing through the atrium and the peristyle, 7 topographic stations have been positioned, from which 660 points useful to define the section parts and 45 control points have been measured, concerning 6 photogrammetric models and 55 photos for the projected parts, from which 16530 points have been extracted.

5.1 The graphic restitution of sections (M.C.)

In the phase of the graphic restitution, after having transformed the graphic elaboration in a bidimensional file, it is necessary to draw differently the elements in section from those in projection: in the first case they are highlighted by a thicker perimetric sign and the different wall typologies are indicated by automatic hatches, according to a Legenda proposed by the Soprintendenza Archeologica di Pompei. In the second case (for instance wall textures, plastered zones, lithic elements), the objects are represented according to their real morphology. This type of differentiated representation underlines the process of masonry analysis and their constructive characteristics, made by the surveyors, and developed in various survey phases.

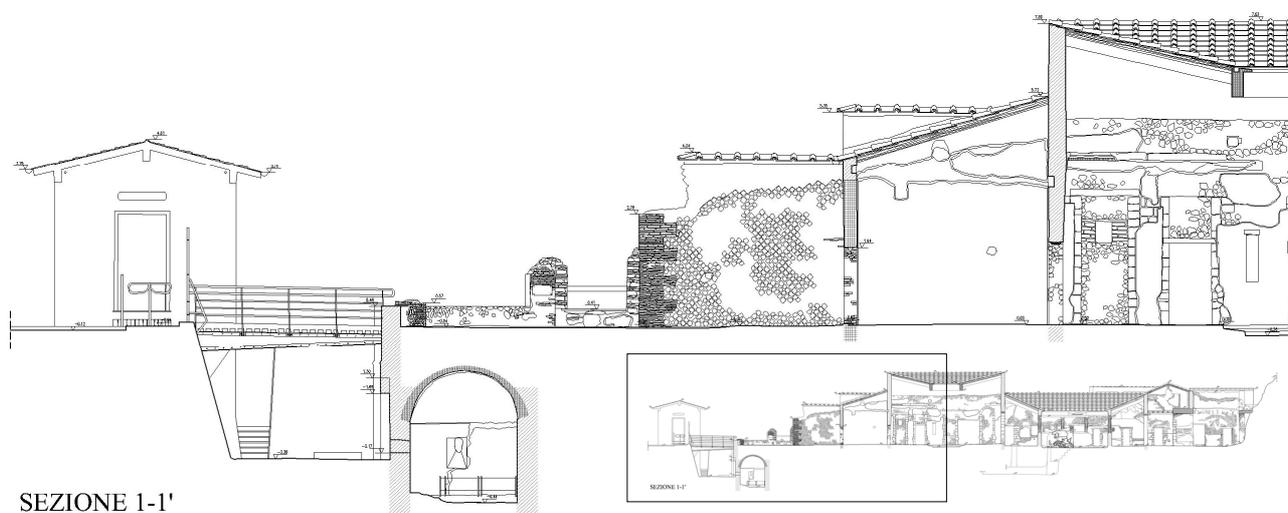


Figure 7 and 8. West-East section: details concerning the portions at West (7) and East (8).

In the case of the drawing relative to East-West section, the details of some rooms are particularly interesting: the entrance's exedra, where there is evidence of a masonry with brick texture in the corner and *opus reticulatum* on the wall; the atrium, with the frescoed walls and the foundation in *opus incertum*, on which it is possible to read the completions of restoration realized in modern age in the superior part of the wall (to notice also the tapering of the atrium door crams); the peristyle, in which the colonnade is shown with some original portions of the trabeation of the roof.

6. CONCLUSIONS (M.C.)

The integrated method, though evidencing remarkable advantages, places critical questions, relied to the use and to the integration of the various methods, to the management of survey gaps, and to the interconnection between survey and graphical elaboration, that has to be inquired.

Concerning the use of different methodologies, topographic, photogrammetric and traditional, some specific acquaintances are necessary from the part of the surveyor regarding the various theoretical foundations of the interested disciplines (topography, photogrammetry, survey, drawing) and the software in use, beyond acquiring historical-archaeological elements of the studied manufacture, so as to acknowledge how to set up the survey procedures and how to issue a graphic elaboration of the survey itself.

Integration turns out to be feasible only when it is possible to acknowledge the modalities to realize the overlapping between the several methods in order to establish certain points in common. Such process will be finalized to the elimination of gaps and to the completion of the elaboration, because a continuous and not discrete entity (such as that of the surveyed architecture) has to correspond to a visual representation equally continuous. The most delicate aspect is exactly the correspondence between a model of survey, which is substantially punctiform, and the final graphical elaboration that is composed generally of several continuous signs.

The surveyor has to care to understand which elements to be measured and to issue the best graphical translation, carrying out an opportune synthesis of the signs, according to the type, the aim and the scale of the produced plan.

In conclusion it can be asserted that such system of integrated survey has to be structured in all its phases according to a project so called "row procedural" which preventively indicates the elaborates to be produced, the procedures to be adopted and the various phases and application times, according to the returned schemes.

In this way, it will be possible to use such methodology also in other experiences, either in archaeological survey fields, than in architectonic ones, considering its peculiarities.

References and Bibliography

Canciani M., 2007. *Sistema informativo geografico come strumento progettuale: il caso di studio del Master Plan della Medina di Costantina (Algeria)*, in Atti del Convegno E-Arcom 07, Ancona.

Maestri D., Canciani M., Spadafora G., 2001. *Archaeological Survey: data processing experimentation and direct observation*, in The Cipa International Archives of Cultural Documentation, Volume XVIII, Berlin.

Maestri D., Docci M., 1999. *Manuale di rilevamento architettonico*. Editori Laterza, Bari 1993, reprint 1999.

Maiuri A., 1931. *La Villa dei Misteri*, Roma, Vol. 2.

Spadafora G., 2006. *Dall'archeologia all'architettura. Il rilevamento per la comprensione dello spazio costruito*. In F. Coarelli, F. Pesando, *Rileggere Pompei. L'insula 10 della Regio VI*, «L'Erma» di Bretschneider, Roma, pp. 370-395.

