

Contemporary Problems of Architecture and Construction

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Architecture and Urban Planning
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Edited by
Narine Pirumyan



Contemporary Problems in Architecture and Construction



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*Edited by
Narine Pirumyan*



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GREETINGS BY THE NATIONAL UNIVERSITY OF ARCHITECTURE AND CONSTRUCTION OF ARMENIA

Gagik Galstyan, Doctor of science (engineering), Professor

Rector of the National University of Architecture and Construction of Armenia

8th International Conference on Contemporary Problems of Architecture and Construction

I'm honored to present these books that collect contributions of local and international researchers on the topic "Contemporary Problems of Architecture and Construction" submitted in the form of research papers.

I would like to thank all researchers, guests, partner universities for their participation. I appreciate the Scientific Committee, Organizing Committee members, Editorial Board and others for their contribution in publishing process of the above mentioned books.

Coordination of up-to-date issues in the field is one of the most important activities in the sphere of science, which unites representatives of different nationalities, exchange their best practices. 8th International Conference on Contemporary Problems of Architecture and Construction is a vivid example of this activity.

Materials of the conference are submitted in two books where 206 researchers are presented. The first book consists of two sections, where articles of 176 authors are included: I Section - Environmental Engineering, Transport Problems, II Section - Civil Engineering, Sustainable Construction, Materials, Structural Mechanics and Technologies. The second book consists of the section-Architecture and Urban Planning, 30 authors are included in this section.

Let me give you a brief update on the way we have overcome together and where we are today. In 2008 National University of Architecture and Construction of Armenia initiated and organized the international conference entitled "Contemporary Problems of Architecture and Construction" in Jermuk, Armenia from October 15 to 18 with participants from Russia, Georgia, Syria. In 2010 the 2nd conference was organized in Jermuk, Armenia from September 30 to October 3 with the participation of representatives from China, Russia and Georgia. The 3rd conference was organized in Beijing, China in collaboration with the Beijing University of Civil Engineering and Construction from November 20 to 24, 2011, with the participation of representatives from China, Armenia, Poland, USA, Russia, France, Italy, UK, Georgia, Moldova and Thailand. The 4th conference was held in the Polish city of Czestochowa from September 24 to 27, 2012, as a joint effort of the Czestochowa University of Technology, National University of Architecture and Construction of Armenia, the Beijing University of Civil Engineering and Construction with the participation of representatives from Poland, Armenia, China, USA, Russia, Italy, Georgia, Czech Republic, Germany, Slovakia, Belarus, Ukraine and Hungary. The 5th conference was organized in Saint Petersburg, Russia by the Saint Petersburg University of Architecture and Construction, National University of Architecture and Construction of Armenia, the Beijing University of Civil Engineering and Construction and Czestochowa University of Technology, which took place from June 25 to 28, 2013. The 6th conference was organized at the University of Ostrava in Ostrava, Czech Republic from June 24 to 27, 2014 with efforts of the VŠB - Technical University of Ostrava, National University of Architecture and Construction of Armenia, the Beijing University of Civil Engineering and Construction, Czestochowa University of Technology, Saint Petersburg University of Architecture and Construction, and the 7th in Florence, Italy at the University of Florence, November 19 to 21, 2015, with joint efforts of the University of Florence, National University of Architecture and Construction of Armenia, the Beijing University of Civil Engineering and Construction, Czestochowa University of Technology, Saint Petersburg University of Architecture and Construction, VŠB - Technical University of Ostrava, with the participation of representatives from Italy, Armenia, China, Poland,

Russia, Czech Republic, Kazakhstan, Iran, Georgia, Ukraine, Portugal, USA, Lithuania, Netherlands, Mexico, Philippines, Columbia.

Hence we are proud to guest in Yerevan (Armenia) the “8th International Conference on Contemporary Problems of Architecture and Construction”, Yerevan (Armenia) held from October 26 to 28, 2016 in cooperation with the partner universities:

- National University of Architecture and Construction of Armenia
- Beijing University of Civil Engineering and Architecture
- Czestochowa University of Technology
- Saint Petersburg State University of Architecture and Civil Engineering
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- The University of Florence

This conference reflects the values and missions of our universities in the best way. This is a platform where close, friendly traditions and relations between countries are getting stronger. It gives an opportunity to numerous scientists from Armenia, China, Poland, Russia, Italy, USA, Georgia, UAE, etc. submit their contributions and open the space for discussions, scientific exchanges.

Hereby I’m sure that each of us would stay engaged, keep proactive, continue to meet the challenges of our fields and help us shape the future of International Conference on Contemporary Problems of Architecture and Construction more comprehensive and ongoing.

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DIGITAL TOOLS FOR THE DOCUMENTATION OF MEDICI'S VILLAS IN TUSCANY

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Keywords: architecture's survey, structure from motion, 3D models, Villa Petraia.

Abstract

The census of Medici's villas is the result of an extended campaign of architectural survey that relates to the study of construction technologies and of formal composition of the systems constituted by buildings and parks to which are connected. The experimentation of the most sophisticated technologies of architecture's survey through laser scanner scanning and photogrammetry have tested the efficacy of these methods on the different elements of the villa: green volumes, walls, decorations and frescoes.

1. Introduction

All the Medici's villas nowadays constitute an important part of the historic and artistic heritage in Tuscany [1]. The villas were considered both as seasonal residences as well cornerstones of the dynastic power and emblems of the control over the territory. Geographically the villas extend from the Mugello, Medici's land of origin, to the coast and the harbour of Livorno. Between the 16th and 17th centuries, the Medici's villas (castles, palaces, simple farms) were approximately forty, surrounded by gardens and farms. The history of every single property brought them to different fates; many of them are owned by the State, heir of the Grand Ducal goods, or by territorial entities of the Regione Toscana, some of the villas are private [2].

In 2013, fourteen of the Medici's villas have entered the list of the UNESCO World Heritage as a serial site, the 49th in Italy. The site "Medici's villas and gardens in Tuscany" comprehends: Boboli's Garden, Villa of Castello, Villa of Petraia, Villa of Careggi and Villa of Poggio Imperiale in Florence, Villa of Cafaggiolo (Barberino del Mugello), Villa "Il Trebbio" (San Piero a Sieve), Garden of Pratolino (Vaglia), Medici Villa in Fiesole and Villa of Cerreto Guidi (Florence), Villa of Poggio a Caiano and Villa of Artimino in Carmignano (Prato), "La Morgia" Villa in Quarrata (Pistoia) and Palace of Seravezza (Lucca).

2. Results/Discussion: Villa Petraia in Florence

"Villa Petraia" (named after the stony environment, where the villa is built) overlooks the Florentine plain from the Morello Mountain and dominates the access ways to the northeastern entrance to the city.

In fact, it is composed by a high medieval tower for sighting, surrounded by the Renaissance villa and the garden (Fig.1),

linked to commission by Cosimo I de' Medici and his son Ferdinando I.

During the eighteenth century, when the Medici dynasty ended, the complex changed owner.

The Lorena family, the new owner, made some changes to the garden. With the Unification of Italy, during the nineteenth century, Florence became the capital City of Italy and the complex became the country residence of Vittorio Emanuele II of Savoy.

He lived here with his wife, Rosa Vercellana, known as "Bella Rosina". During the last decades the villa was transformed into a national museum and, in 2013, it became part of the site "Medici's villas and gardens in Tuscany", part of the UNESCO World Heritage.

Villa Petraia imposed itself as the model of the villa with tower, replicated in many examples in the Tuscan country.

The simple and linear facades don't oppress the polychromies of the inside courtyard, frescoed by Cosimo Daddi at the end of the sixteenth century, with episodes of the conquer of Jerusalem, and by Baldassare Franceschini, during the seventeenth century, to celebrate the family Medici.

In the Savoy period the courtyard (Fig.2) itself became a party room, in order to host the dancing, by building in 1870 a skylight glass and cast iron covering the big central space for the marriage of one of king's son.

In addition, a Venetian mosaic floor based on the surrounding frescos was posed on the ground.

The entire decorative complex resulted extolled, anticipating the fusion between the existing parts of many different historical periods present in the rooms distributed on the two floors. In these spaces the Grand Ducal collections are mixed with the furniture by the period King's Vittorio Emanuele II.

The gardens have had many changes during the centuries but the frontal garden has stayed similar to the general lines of the Renaissance style. This is witnessed by Giusto Utens's lunettes, inside the ground floor museum of the Villa.

During the 70s of the sixteenth century, the hill underwent big excavation works, which have regularized the pendency and have created three sloping terraces.

Every terrace is characterized by its own architectural design. The inferior one, named "Parterres", develops on a median axis with a "candelabrum fountain" built on its center; the

citrus are alternated to bushes low-height regular-shaped with seasonal multicolored blooms.

The second terrace, the “Vivarium”, has a big rectangular pool, water reserve of the villa and the garden, and once also used to raise fishes as a food source. The last terrace is named “Figurina”, because of the presence of Giambologna’s Fiorenza (original of the 1580 ca. now located in the inside) above the fountain, transported from the adjacent Villa of Castello in 1788. The flowerbeds, surrounded by terracotta leaves, belong to the Savoy period. This small pavillion, built before 1872, follows the nineteenth century style (in fact it is composed by brickwork, glass and cast iron) and was designed as a relax place [3].



Fig. 2 Pictures of the garden and of the courtyard

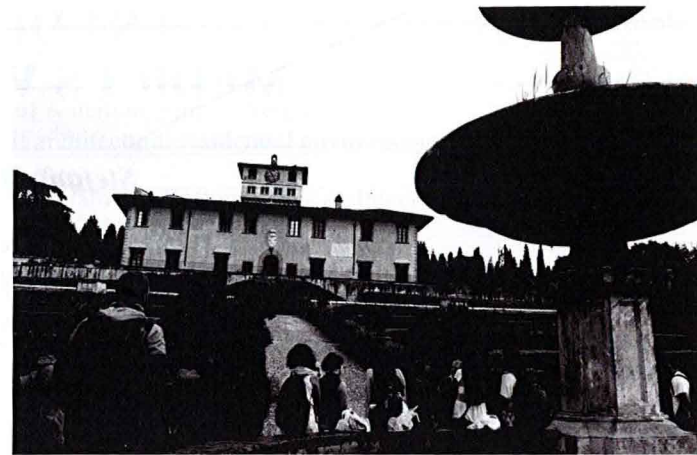


Fig. 1 Picture of the Villa Petraia from the garden



3. Tools and methodologies used in the case studies

The issues related to the preparation of the “management plan” of the sites recognized as a World Heritage Site protected by UNESCO, requires to the institutions and administrations shareholders “a cycle of planning, implementation, monitoring, evaluation of corrective actions” that meet the requirements and guidelines UNESCO [4].

To the “Laboratory of Survey of the Architecture”¹ has been proposed a significant contribution on the topic of digital

survey of the system of the Medici villas in Tuscany, starting from Villa Petraia².

The cataloguing and documentation of the structures and of the environmental system of the heritage sites is one of the basic aspects for the proper management of monitoring and of the prospects for development. The survey, with the contemporary digital methods, in addition to diagnostic and monitoring, are the elements that make up the basic steps of a process of planning and programming of conservation.

The info-graphical technologies and digital surveying systems can be used in various fields of architectural studies and, first of all, they offer numerous applications concerning the management of the extensive documentation of the buildings and for each measurement's campaign. Generally one of the main purposes is to prepare a database concerning the documentation of a so important site, like the UNESCO sites, that can be easily accessed and updated, organized in order to be online accessible and at disposal of research teams, even

² Institutions involved in the research program are: University of Florence; University of Pavia; Shenkar College of Design and Engineering, Israel; Special Superintendence for the Historical, Artistic, Ethno-anthropological and Museums of the city of Florence; Superintendence for Architectural, Landscape, Historical, Artistic Anthropological Heritage for the provinces of Florence, Pistoia and Prato. Florence, Italy.

¹ The “Laboratory of Survey of the Architecture” -LRA of the Department of Architecture of the University of Florence is a laboratory aimed to educational programs and researchs about the Architectural and Archaeological Heritage.

It produces surveys on the architectural, the urban and landscape environments integrating the competences that are now being employed in the sectors fields of documentation and preservation of the Heritage. These activities may also support the public and private institutions operating in the sector of Cultural Heritage.

The transfert of knowledge represents the fundamental element, which can valorize or potentiate the formative offer through the scientific experiences. In addition, these experiences permit to tune the operative methodologies for the digital architectural survey, giving essential instruments in order to understand and evaluate the preservation and restoration interventions. Partnerships: CyArk (USA); SINECO (ITA), Microgeo srl, (ITA).

<http://www.didat.unifi.it/vp-206-laboratorio-di-rilievo-dell-architettura.html>

internationally, due to the interdisciplinary nature of the study [5].

These databases are essential tools for the management and the archiving of survey's documentation, for instance of notes taken during the fieldwork, of surveys made by means of digital equipment, of source files up to definitive documentation and drawings, of images and pictures.

If well organized, the data gathering can offer the possibility to carry out studies for didactic works or researches in various fields.

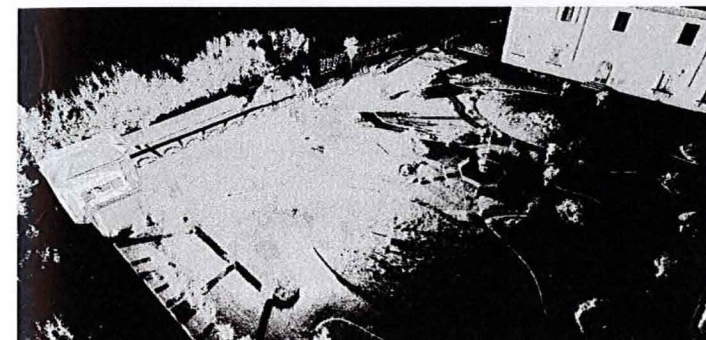


Fig. 3 Screenshot of the visualization from laser scanning

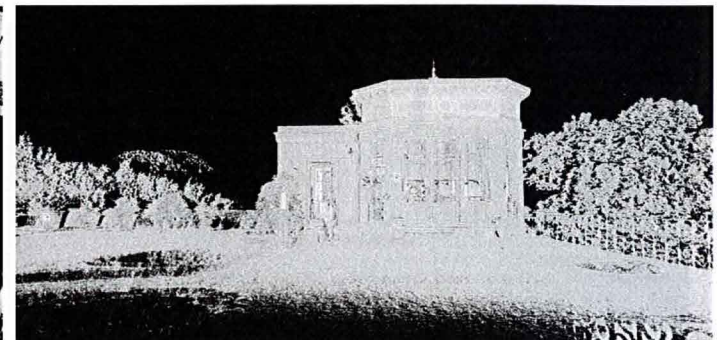
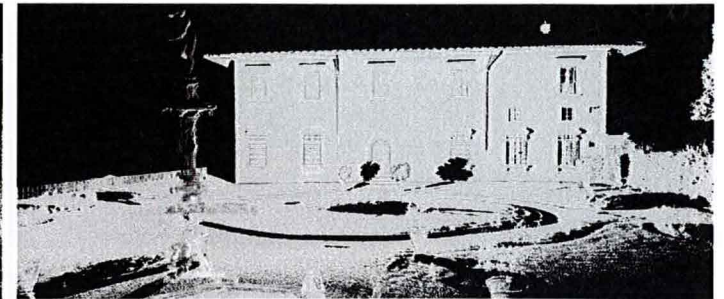
The photography, which is nowadays an essential tool in the context of an architecture's survey, is used in all the processes of environmental survey: even a non-expert operator in architectural survey (from scientific and technical point of view), can carry out a campaign with adequate digital devices.

Using some applications of digital photography, not only the majority of the dimensional and qualitative aspects of a place can be gathered, but it's also possible to reconstruct geometrically the space, in order to obtain threedimensional models to better understand the object, both from the point of view morphological as well the material issue (Fig.3).

The data acquisition step and the processing of a part of the archaeological site of Villa Petraia, by means of an accurate photographic survey campaign, was aimed at the creation of three-dimensional models directly from pictures, describing the current condition of the monument and comparable with the point cloud from the laser scanner in order to verify the

The introduction of digital devices, adapted to the requirements of each different sector, allows the enhancement of the wide iconographic and documentary material gathered by a team of scholars and experts working in a particular area.

The results of the architecture's survey, aimed at defining the spatial qualities of a space, and aimed at accurately describing the building surfaces, is the result of several activities, requiring a more and more quick data acquisition, not only with metric reliability, but also with more immediate descriptive qualities [6].



metric reliability and, if present, some dimensional differences.

The procedure “structure from motion” was used for the construction of virtual models, often directly created from photographic images.

The quick data acquisition and the quite rapid creation of models have made this tool increasingly interesting for the field of architecture's survey, and moreover offer the possibility to use them in an interactive virtual environment can disseminate to a wider public the awareness of the places.

An example of the development of these methods is shown by the results of the survey campaigns carried out in 2015 and 2016 at Villa Petraia: the virtual reality systems can help the representation of spaces, supporting users for the study and development of simplified models of the environment thanks to automated systems that, starting from simple series of photographs, are able to process and automatically create highly descriptive 3D models.

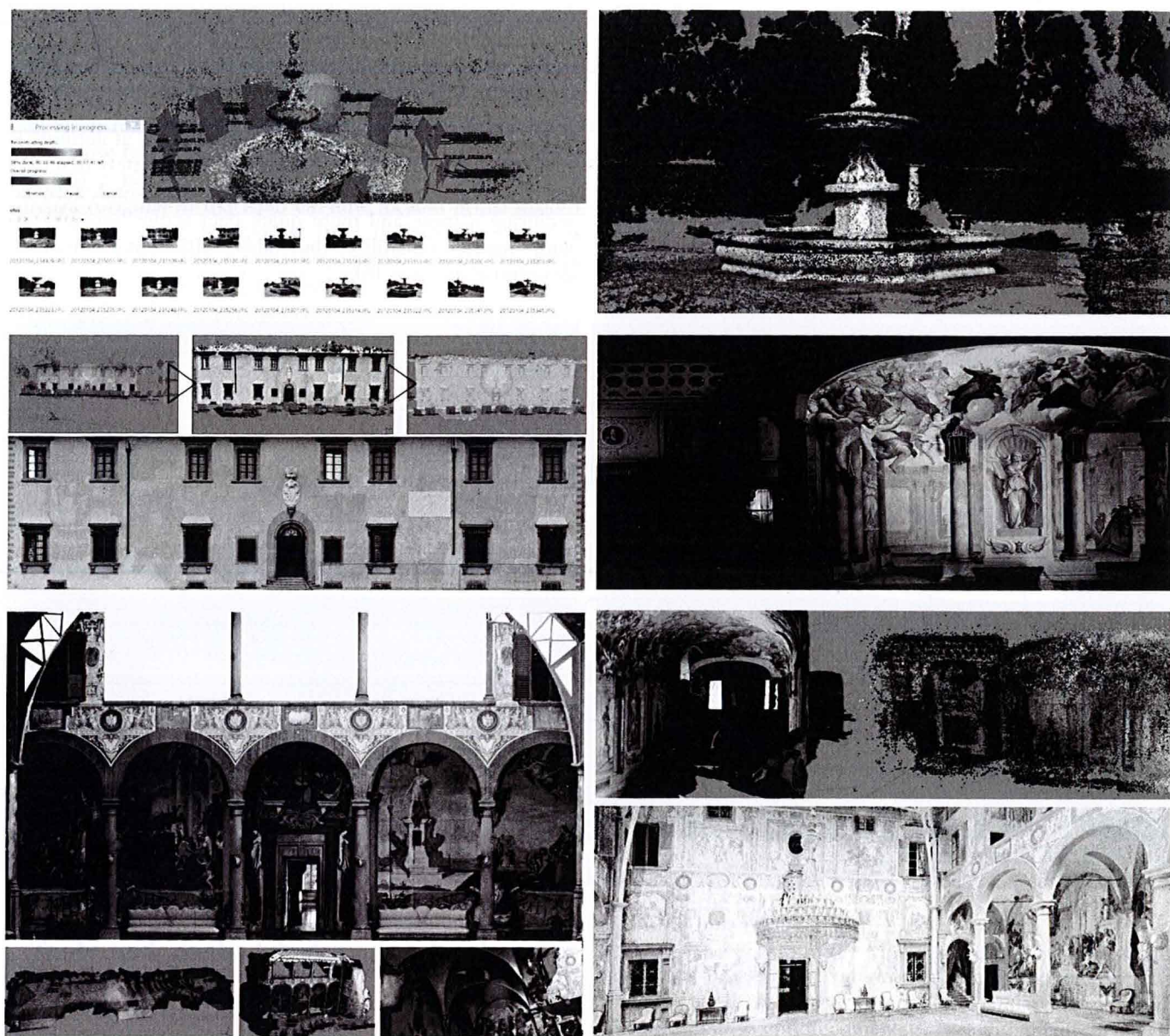


Fig. 4 Screenshot of the visualization from the procedure "structure from motion"

4. Conclusions

Based on the experience carried out in this specific field, operational protocols could be prepared, considering the complexity of the problem to define clearly even the methodological level, because of continuous innovation offered by digital devices.

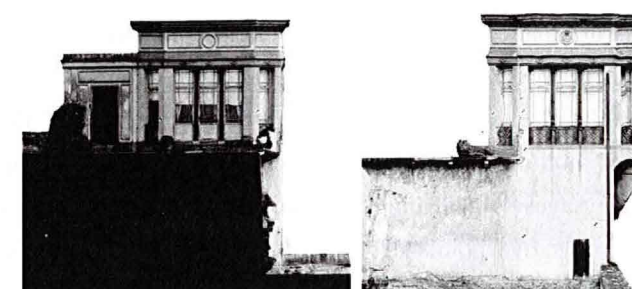
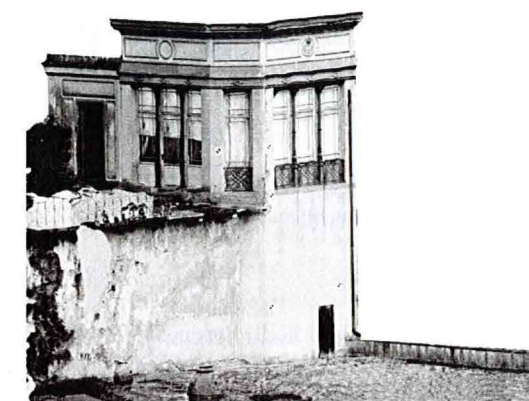
However it could be important to use a reference methodology at an interdisciplinary level, shared with other fields and approved by UNESCO [7].

Developments and dissemination of innovative IT solutions for preservation and maintenance of cultural heritage, are used to document works of cultural heritage and ensure its management as well as its aware and proper use [8].

We are moving towards the integration of new knowledge with existing structures database (for example, the information systems of public and private preservation institutions, research centres, museums, etc.), meaning that the disciplinary field of Digital Representation and Survey can have a more relevant role.



Fig. 5 Pictures of the fieldwork in the Villa Petraia



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IN MERITO AL RICONOSCIMENTO DI AUTORELITA' DICHIARA

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Si dichiara che i paragrafi:

- Tools and methodologies used in the case studies;
- Conclusions;

Sono stati scritti dalla candidata e che, per scelta editoriale, tale indicazione non è stata mantenuta
dall'editore.

Firenze, 14 luglio 2017

In fede
Paola Puma

