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STEFANO BERTOCCI
FEDERICO CIOLI

Franciscan Landscapes

Conservation, Protection and Use of Religious Cultural Heritage in the Digital Era

vol. 1

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This volume collects the papers presented at the concluding conference of the European project 'F-ATLAS: Franciscan Landscapes: The Observance between Italy, Portugal and Spain' that took place in Assisi, May 11-13, 2023.
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Porziuncola, Assisi (Italy). Drawing by Stefano Bertocci.

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VOLUME 2

DOCUMENTATION AND VALORIZATION OF CONVENTS OF MINOR ORDERS AND THE MOST IMPORTANT PILGRIMAGE SITES IN TUSCANY. THE CASE STUDY OF SAN VIVALDO IN MONTAIONE (FI)

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Abstract

The complex of the Sacro Monte and the Convent of San Vivaldo is considered one of the most interesting places of pilgrimage in Tuscany. Its location is of high landscape value, and in 1984, it was declared a national monument. San Vivaldo represents one of the most significant points within the network of places of pilgrimage and devotion represented by the Sacred Mountains. The complex today consists of the Church, the Convent and eighteen chapels located in the green around the convent complex, which, in the original project (first quarter of the sixteenth century), ideally reproduced the Holy City of Jerusalem. The convent and church were built at the beginning of the 16th century. The complex was studied by designing a 3D digital survey using the appropriate technologies to provide the metric, morphological and material knowledge necessary for the property's documentation, preservation and enhancement

Keywords: Sacred Mount, San Vivaldo, F-ATLAS, Documentation, laser scanner 3D, SfM, friars Minor, Franciscan

Fig. 1
General plan of the complex of San Vivaldo, the Monastery and the Sacred Mount's chapels.

1. Introduction

The project for the survey and enhancement of the site of San Vivaldo is part of the European project 'F-ATLAS – Franciscan Landscapes: the Observance between Italy, Portugal and Spain' (http:///www.f-atlas.eu), with the participation of the Department of Architecture of the University of Florence (DiDA), the ISCTE-IUL of the University of Lisbon, the University of Barcelona and the UCP-CEHR of the Portuguese Catholic University. The project is developed within the JPI-CH program (Joint Programming Initiative in Cultural Heritage). It offers technologies and methodologies of analysis and research to assess the conservation conditions of the Italian-Portuguese-Spanish Franciscan mendicant network. This research aims to create an 'atlas' that documents the level of knowledge of the monuments concerned to prepare strategies for their conservation, protection and promotion of the sites under study (Parrinello et al., 2017).

opposite page
Fig. 2
Picture of San Vivaldo in the surrounding landscape.

The Franciscan complex of the Sacro Monte and the Convent of San Vivaldo in Montaione (FI) is considered one of the most interesting places of pilgrimage in Tuscany. Because its position is of high landscape value, in 1984, it was declared a national monument.

It is also a spiritual, cultural and tourist reference point for Valdelsa, the whole Province of Florence, and the neighbouring provinces of Pisa and Siena. Finally, the site of San Vivaldo represents one of the most significant points within the network of places of pilgrimage and devotion represented by the Sacred Mounts.

San Vivaldo today consists of the Church, the Convent entitled to San Vivaldo and eighteen chapels located in the green around the convent complex, which, in the project of the original plant (first quarter of the sixteenth century), ideally reproduced the Holy City of Jerusalem.

The chapels host inside plastic groups depicting episodes of the life of Christ that occurred in the places of the Holy City and Palestine.

In some cases, the formal, stylistic and architectural peculiarities of the chapels directly refer to the memory and description of the buildings of the Holy Land. The chapels that form the route of the Sacred Mount of San Vivaldo were not randomly located within the wooded green area. Still, this place was chosen for its specific geographical similarity with Jerusalem's territory, and the Gerosolimitan model's topography was repeated (Ghilardi, 1895).

The convent and the church were built in the early sixteenth century: the first intervention was the construction of a devotional chapel in honour of San Vivaldo. To this were added, in several stages, the structures of the church and the convent until the construction and expansion of the Franciscan seminary occurred in the nineteenth century (Amonaci, 1997).

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Fig. 3
Environmental section of the Sacro Monte.

2. Working Method and Survey Project

In conserving monuments, a method of intervention is necessary to allow the broadest possible vision and knowledge of the good. In this regard, our research team, for several years, prefers to establish collaborative projects with a large multidisciplinary study group. The study of the complex was addressed through the design of a 3D digital survey using the appropriate technologies to provide the metric, morphological and material knowledge necessary for the documentation, safeguarding and enhancement of the good (Arrighetti et al., 2019). At a later time, the events of the factory on how it developed were taken into account, evaluating the stratigraphies of the walls, especially concerning the part relating to the monastery (Pancani, Bigongiari, 2020) and any structural problems it has reported (Paradiso et al., 2014). The research on the documents and the analysis of the events that have contributed to the evolution and current state of the complex of the sacred mountain will be a comfort to give a sufficiently accomplished cognitive framework to possibly proceed with actions to maintain the recovery and enhancement of the site.

The survey was carried out within the framework of the research programme 'F-ATLAS – Franciscan Landscapes: the Observance between Italy, Portugal and Spain' (http://www.f-atlas.eu), a European project developed within the JPI-CH programme (Joint Programming Initiative in Cultural Heritage). This program uses methodologies of analysis and knowledge to assess the current state of the Italian-Portuguese-Spanish Franciscan mendicant network. With this work, it is planned to create an 'atlas' of metric-morphological documentation, which can provide adequate tools to improve knowledge for the conservation and protection of the studied assets.

The work was dealt with in annual steps, during which the individual factories of the San Vivaldo complex were examined.

The complete survey of the eighteen chapels that make up the complex of the Sacred Mount was made, and the survey of the church and the convent has been completed. The Chapels were surveyed during the spring of 2021 during a pandemic; a tiny group of surveyors worked there to limit any possible infections. The work, however, was conducted with extreme care, and the first results were summarised in Greta Safina's dissertation (Safina, 2021). The first phase of the survey was realised with a laser scanner Z+F 5016, very versatile instrument with excellent data regarding the quality of the point cloud with outstanding performance of accuracy and precision. The device has a refined HDR (High Dynamic Range) photographic capture system(Safina, 2021), thanks to which it has been possible to make high-definition scans with a very high texture quality.

The general point cloud, relative to the survey of the chapels of the Sacred Mount, has seen the recording of all the scans of the interior with that more general of the exterior through a path of work that would retrace a path that we can assimilate to a closed polygonal topographic type (Banterle et al., 2009).

With this work method, it was possible to verify that there were no errors greater than 1.5 cm at the time of registration, with checks carried out regularly at each step and/or group of scans recorded. However, further checks on the complete point cloud were carried out to certify the overall quality of the survey. Thanks to the features acquired by the new versions of the Leica Cyclone©software, it was possible to compensate for any minor errors that emerged, dividing them among all the scans (Pancani, 2017). This feature allowed to correct small but significant errors between the various recordings.

The laser scanner survey was followed by a SfM (Structure from Motion) photogrammetric survey (Rinaudo, 2017) used inside the church for the realisation of photomodels through the acquisition of the images of the altars decorated with polychrome terracotta inside the chapels. A first SfM (Structure from Motion) aero-photogrammetry was also performed with a drone DJI Mavic2 Pro, which detected the territorial context on which rise the Chapels. However, for the survey of the eighteen chapels, which represented the nucleus of the first significant campaign, a point cloud was obtained that, together with the qualities of the small buildings, contextualised the insertion in the surrounding landscape. On the other hand, this need has become indispensable to assess the location of the chapels of the sacred mount and to compare them with the position that the various stations of the Passion of Christ have in their original place in Jerusalem (Verdiani et al., 2014).

In the 1:50 scale restitution of the chapels of the sacred mountain, all the profiles of the buildings have been accurately described, together with an accurate photogrammetric restitution of all the internal and external surfaces. Moreover, with particular care, the terracotta sculptures representing the passion of Christ were represented. The orthophotoplanes have been realised using SfM photomodelling methods, to realise which the 3DZephyr software has been used.

Fig. 4
The cloud of points of the laser scanner survey of the San Vivaldo convent.

In the spring of 2022, the San Vivaldo monastery complex was surveyed. The survey was made with a laser scanner Faro M70, a light and handy tool, with which 551 scans were made, acquired with an average mesh of about 7 mm. In this case, the scans were carried out without the relative acquisition of the photographic images. The survey produced a considerable amount of data, stored, recorded and processed in a file of 175 GB. Again, the laser scanner survey was subjected to an accurate verification and certification protocol. For the realisation of the orthophotoplanes, a photomodeling with SfM technique was performed. In this regard was used a drone (UAV Unmanned Aerial Vehicle, unmanned aircraft) DJI mavic 2 pro and DJI mini 3 pro (Arbeid, Matteoli, 2021).

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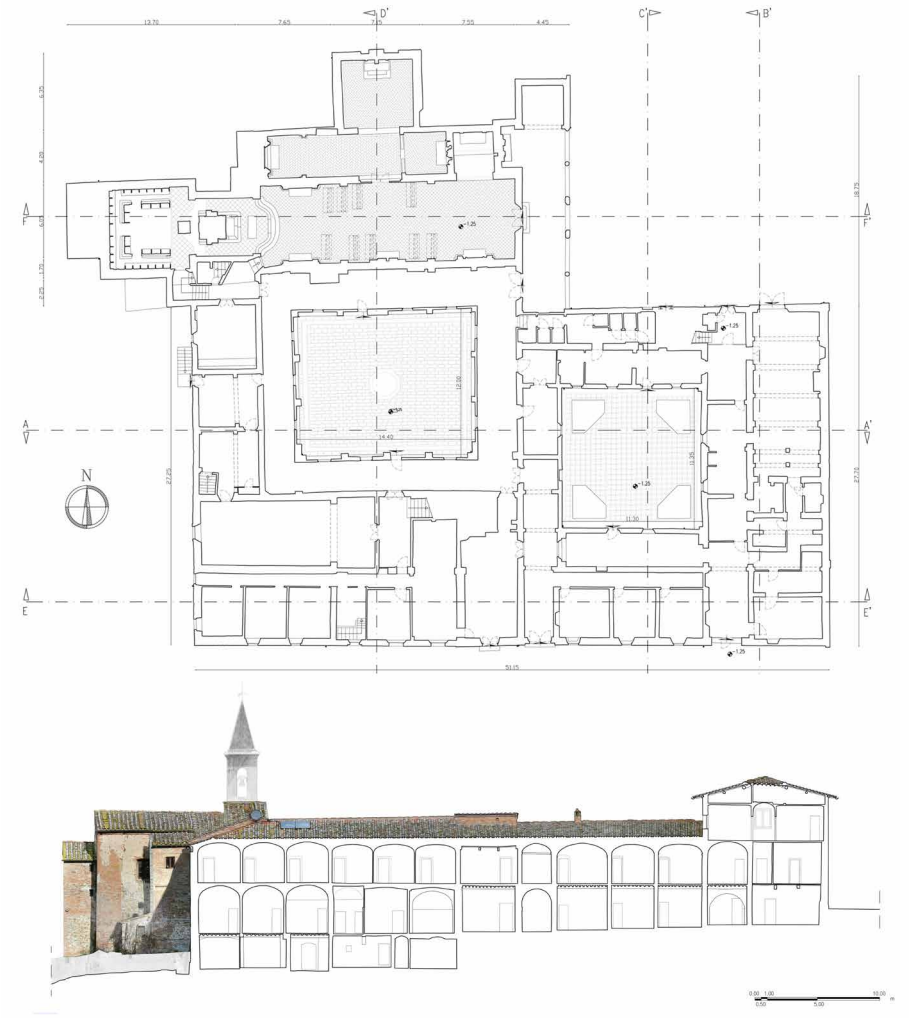
Fig. 5
Restitution of the survey, above Plan of the ground floor, under Section E-E', goes through the cells of the friars.

The mesh model was scaled both with the GPS data derived from the aerial images and later, for a refinement of the data, the data of the laser scanner survey were used. For the restitution, the ortho-images extracted from Cyclone were used, first for realising the plans and the interior sections of the church and monastery. For these elaborates, the same graphical methodology has been used in the restitution of the chapels of the Sacred Mount, with the realisation of the drawn profiles and the orthophotoplanes extracted from the mesh-model textured suitably scaled and calibrated on the point cloud.

3. Conclusions

The Valdelsan plan was accurately recorded in its component of the architectural complex of the convent and the chapels and its orography and topography. The Sacred Mount has been compared with the historical plan of Jerusalem, particularly that of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C'
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12.70
7.65
7.55
4.45
51.15
14.40
11.30
27.25
18.75

Fig. 6
The two drones (UAV Unmanned Aerial Vehicle, unmanned aircraft) DJI Mavic 2 pro left, and DJI mini 3 pro right, at work.

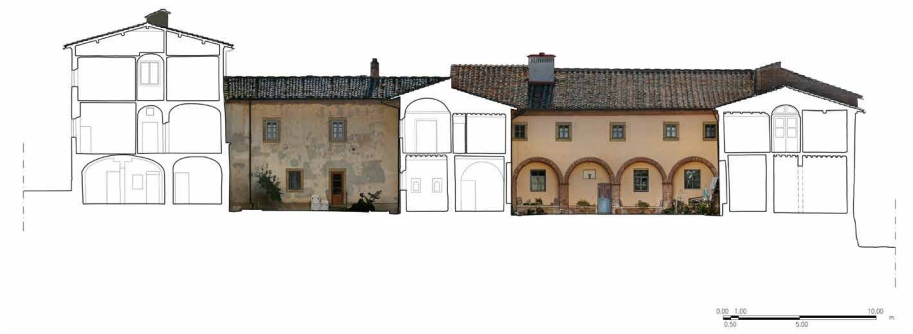
opposite page
Fig. 7
Section A-A', cuts the convent through the two cloisters.

Fig. 8
South prospect of the monastery with Ortophotoplan.

Fig. 9
East prospect of the monastery with Ortophotoplan.

the 15th century, especially going to read and verify the travel reports published in the 13th-14th centuries. However, the aspects that emerged from the research carried out in San Vivaldo were also evaluated; particular attention was paid to the entire spectrum of documentation, the area's orographic conformation, and the chapels' arrangement on the ground, their architectural events.

The small temples, different in shape and size, were distributed in the space near the convent, particularly on the wooded hill south of the convent and along the road leading to the nearby village of San Vivaldo. The disposition is organised in an order that repeats the dislocation and sequence of the sanctuaries venerated in Jerusalem; so that the conformation of the sacred mountain is not due to chance but is based on a project that refers to the precise correspondence of the complex to the intentions of its creator, and in line with the arrangement of the holy places in the city of Jerusalem. In the end, the metric-morphological and material survey was dealt with, allowing us to start making interesting assessments on the conformations of the sacred mountains and the actual topomimetic correspondence in the realisation of the Tuscan Sacred Mount. At the same time, the documentation and the representations of the property have provided us with an indispensable framework for preserving and enhancing the monument.



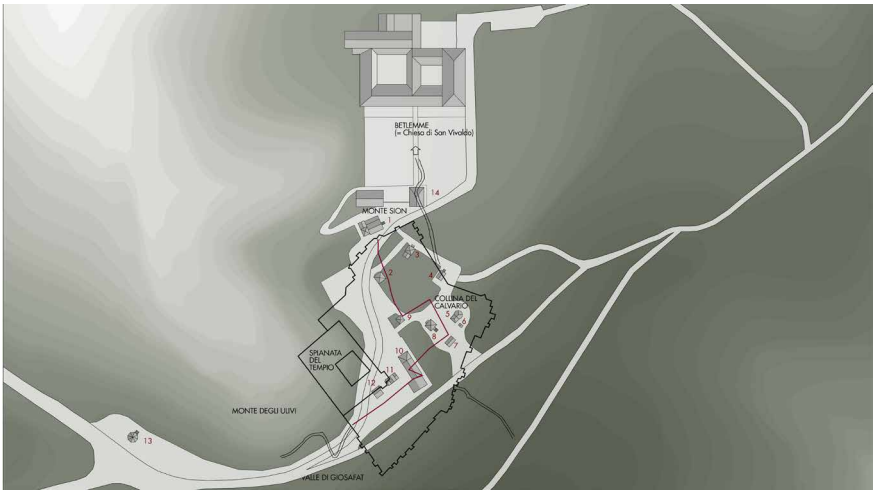


Fig. 10
The superimposition of the plan of Jerusalem scaled on that of San Vivaldo to compare its coincidences.

Fig. 11
West prospect of the monastery with Ortophotoplan.

Bibliographical references

Amonaci A. M. 1997, *Conventi toscani dell'Osservanza Francescana*, Cinisello Balsamo, Silvana Editoriale, pp. 195-205.

Arbeid B., Matteoli L. 2021, *Archeologia e architettura a dialogo per la Tomba dell'Arciere a San Casciano in Val di Pesa (FI)*, in (ed) Arbeid B., Pessina A., Tarantini M., Tutela, Restauro 2020, *Notiziario della Soprintendenza Archeologia Belle Arti e Paesaggio per la città metropolitana di Firenze e le provincie di Pistoia e Prato*, All'Insegna del Giglio, Sesto Fiorentino (FI), pp. 183-200.

Arrighetti A., Pancani G., Gentili M. 2019, *La Pieve di Santa Maria a Buiano in Casentino. rilievo e lettura archeologica delle architetture per il progetto HBIM*, "Archeologia dell'Architettura", vol. XXIV, pp. 157-176, (ISSN: (print) 1126-6236).

Banterle F., Debattista K., Artusi A., Pattanaik S., Myszkowski K., Ledda P., Chalmers A. 2009, *High Dynamic Range Imaging and Low Dynamic Range Expansion for Generating HDR Content*, Computer Graphics forum, Volume 28, number 8 pp. 2343–2367.

Ghilardi F. 1895, *San Vivaldo in Toscana: monografia*, Firenze, Tipografia di E. Ariani.

Pancani G., Bigongiari M. 2020, *Digital survey for the structural analysis of the Verruca fortress*, in PROCEDIA STRUCTURAL INTEGRITY, vol. 29, pp. 149-156.

Pancani G. 2017, *La città dei Guidi: Poppi. Il costruito del centro storico, rilievi e indagini diagnostiche*, Edifir, Firenze, pp. 1-178

Paradiso M., Galassi S., Sinicropi D. 2014, *Stabilità di archi e volte in muratura: metodi tradizionali e calcolo automatico*, in *Patologia della Costruccion, Tecnologia de la Rehabilitacion y Gestion del Patrimonio, Villegas L. Lombillo I. Liano C. Blanco H. (Eds)*. Gráficas Iguña S.A., Proc. Of Latin American Congress on "Construction Pathology, Rehabilitation Technology and Heritage Management, Rehabend 2014, Santander, Spain, pp. 960-969.

Parrinello S., Picchio F., De Marco R. 2017, *Pavia 3D: Reading and decomposition of the city for the construction of dynamic databases on heritage*, Vestnik permskogo nacional′nogoissledovatel′skogopolitehničeskogouniversiteta. p rikladnaâèkologiâ, urbanistikapp. pp. 24-35.

Parrinello S. 2020, *Cultural Heritage analysis practices conducted through the use of drones: towards a renewed dimension of research*, in (ed) Barba S., Parrinello S., Dell'Amico A., Limongello M., D-SITE Drones - Systems of Information on culTural hEritage. For a spatial and social investigation, Pavia, Pavia University Press, pp. 20-31.

Rinaudo F. 2017, *Analisi della qualità del rilievo laser scanner architettonico e criteri di verifica*, in Pancani G., La città dei Guidi: Poppi. Il costruito del centro storico, rilievi e indagini diagnostiche, Firenze, Edifir, pp. 25-37.

Safina G. 2021, *Il complesso di San Vivaldo*, Tesi di Laurea, Relatore Bertocci S., Correlatori: Pancani G., Matteoli L., Università degli Studi di Firenze, Dipartimento di Architettura.

Verdiani G., Pacciani R., Mastroberti C. 2014, *A place of faith and devotion and its contemporary re-reading, the digital survey and interpretation of the San Vivaldo "Jerusalem" area near Florence*, Electronic Imaging & the Visual Arts. EVA 2014 Florence, Firenze, 07-08/05/2014, FUP - Firenze University Press, pp. 62-67

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Integrating historical research with technological progress opens exciting possibilities to create comprehensive digital archives, virtual reconstructions, and immersive experiences that can bridge the gap between the past and the present.

Stefano Bertocci is Full Professor at the Department of Architecture of the University of Florence. He led numerous research projects on the opportunities offered by 3D digital surveys and remote sensing in archaeology, architecture, and urban planning. His major works include research on Architectural Heritage in Europe and Latin America, wooden architecture in Russia and investigations of various archaeological sites in Europe and the Middle East.

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