

a cura di
STEFANO BERTOCCI
FEDERICO CIOLI

Franciscan Landscapes

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

vol. 1



La serie di pubblicazioni scientifiche della **Collana Bianca** ha l'obiettivo di diffondere i risultati delle ricerche e dei progetti realizzati dal Dipartimento di Architettura DIDA dell'Università degli Studi di Firenze in ambito nazionale e internazionale.

Ogni volume è soggetto a una procedura di accettazione e valutazione qualitativa basata sul giudizio tra pari gestita dal Comitato Scientifico della Collana Ricerche. Architettura, Pianificazione, Paesaggio, Design del Dipartimento di Architettura con Firenze University Press. Tutte le pubblicazioni sono inoltre *open access* sul Web (didapress.it), per favorire non solo la diffusione ma anche una valutazione aperta a tutta la comunità scientifica internazionale.

Il Dipartimento di Architettura dell'Università di Firenze promuove e sostiene questa collana per offrire un contributo alla ricerca internazionale sul progetto, sia sul piano teorico-critico che operativo.

*The **Collana Bianca** series of scientific publications has the purpose of disseminating the results of national and international research and project carried out by the Department of Architecture of the University of Florence (DIDA).*

The volumes are subject to a qualitative process of acceptance and evaluation based on peer review, which is entrusted to the Scientific Publications Committee of the Department of Architecture with Florence University Press. Furthermore, all publications are available on an open-access basis on the Internet (didapress.it), which not only favors their diffusion, but also fosters an effective evaluation from the entire international scientific community.

The Department of Architecture of the University of Florence promotes and supports this series in order to offer a useful contribution to international research on architectural design, both at the theoretico-critical and operative levels.

Editor-in-Chief

Francesco Valerio Collotti | University of Florence, Italy

Scientific Board

Gianpiero Alfarano | University of Florence, Italy; **Barbara Aterini** | University of Florence, Italy; **Carla Balocco** | University of Florence, Italy; **Susanna Caccia Gherardini** | University of Florence, Italy; **Maria De Santis** | University of Florence, Italy; **Letizia Dipasquale** | University of Florence, Italy; **Giulio Giovannoni** | University of Florence, Italy; **Lamia Hadda** | University of Florence, Italy; **Anna Lambertini** | University of Florence, Italy; **Francesca Mugnai** | University of Florence, Italy; **Luisa Rovero** | University of Florence, Italy; **Marco Tanganelli** | University of Florence, Italy

International Scientific Board

Daniela Bosia | Politecnico di Torino; **Nicola Braghieri** | EPFL - Swiss Federal Institute of Technology in Lausanne, Switzerland; **Lucina Caravaggi** | University of Rome La Sapienza, Italy; **Federico Cinquepalmi** | ISPRA, The Italian Institute for Environmental Protection and Research, Italy; **Margaret Crawford**, University of California Berkeley, United States; **Maria Grazia D'Amelio** | University of Rome Tor Vergata, Italy; **Francesco Saverio Fera** | University of Bologna, Italy; **Carlo Francini** | Comune di Firenze, Italy; **Sebastian Garcia Garrido** | University of Malaga, Spain; **Medina Lasansky** | Cornell University, United States; **Jesus Leache** | University of Zaragoza, Spain; **Heather Hyde Minor** | University of Notre Dame, United States; **Tomaso Monestiroli** | Politecnico di Milano; **Danilo Palazzo** | University of Cincinnati, United States; **Pablo Rodríguez Navarro** | Universitat Politècnica de València, Spain; **Ombretta Romice** | University of Strathclyde, Scotland; **Silvia Ross** | University College Cork, Ireland; **Monica Rossi-Schwarzenbeck** | Leipzig University of Applied Sciences, Germany; **Jolanta Sroczynska** | Cracow University of Technology, Poland; **Hua Xiaoning** | Nanjing University

Emeritus Board

Paolo Felli | Emeritus Professor, University of Florence
Saverio Mecca | Emeritus Professor, University of Florence
Raffaele Paloscia | Emeritus Professor, University of Florence
Maria Concetta Zoppi | Emerita Professor, University of Florence

edited by
STEFANO BERTOCCI
FEDERICO CIOLI

Franciscan Landscapes

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

vol. 1





UNIVERSITÀ
DEGLI STUDI
FIRENZE

DIDA
DIPARTIMENTO DI
ARCHITETTURA

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.

The publication underwent a peer-review-based acceptance and qualitative evaluation procedure entrusted to the conference's Scientific Committee using the double peer-blind review system.

F-ATLAS CONFERENCE – Franciscan Observance Landscapes, Assisi, May 11-13, 2023.

Promoting Committee

Stefano Bertocci, Soraya Genin, Maria Soler Sala, Maria Filomena Andrade.

Organizing Committee

Maria Filomena Andrade, Stefano Bertocci, Federico Cioli, Anastasia Cottini, Blanca Garí de Aguilera, Soraya Genin, João Luís Inglês Fontes, Núria Jornet Benito, Francesco Salvestrini, Maria Soler Sala, Carlos Fernando Teixeira Alves, Rolando Volzone.

Scientific Committee

Filomena Andrade, Stefano Bertocci, Fabio Bianconi, Matteo Bigongiari, Stefano Brusaporci, Alessandro Camiz, Pilar Chías Navarro, Xavier Costa Badia, Gabriel Horacio Defranco, Francesca Fatta, Maria Dolores Fraga Sampedro, Isabella Gagliardi, Blanca Garí de Aguilera, Soraya Genin, Saul António Gomes, Andrea Giordano, Anna Guarducci, João Luís Inglês Fontes, Nuria Jornet Benito, Rosa Lluch Bramon, Federica Maietti, João Luís Marques, Luciano Migliaccio, Andrea Nanetti, Sandro Parrinello, Silvia María Pérez González, Francesca Picchio, Cristiano Riminesi, Pablo Rodríguez-Navarro, Maria de Lurdes Rosa, Adriana Rossi, Francesco Salvestrini, Maria Soler Sala, Roberta Spallone.

Scientific Secretariat

Roberta Ferretti.

'F-ATLAS – Franciscan Landscapes: the Observance between Italy, Portugal and Spain' project was funded in 2020 by the JPICH 2019 Conservation, Protection and Use Call.

Project Leader: Università degli Studi di Firenze.

Principal Investigators: ISCTE Instituto Universitário de Lisboa, Universitat de Barcelona, Universidade Católica Portuguesa.

Associate Partners: ICOMOS Portugal, Sisma srl, Regione Umbria, Direção Regional de Cultura do Centro, Provença Serafica di San Francesco d'Assisi dei Frati Minori.

in copertina

Porziuncola, Assisi (Italy). Drawing by Stefano Bertocci.

progetto grafico

didacommunicationlab

Dipartimento di Architettura
Università degli Studi di Firenze



didapress

Dipartimento di Architettura
Università degli Studi di Firenze
via della Mattonaia, 8 Firenze 50121

© 2024

ISBN 978-88-3338-222-7

Stampato su carta di pura cellulosa Fedrigoni Arcoset

ELEMENTAL
CHLORINE
FREE
GUARANTEED



HEAVY METAL
ABSENCE
OF

INDEX

VOLUME 1

Introduction	15
Stefano Bertocci, Federico Cioli	
Presentation	
Francesco Piloni	19
Foreword	
Giuseppe De Luca	21
Benedictine Monasteries in Umbria. A Benchmark of the Monastic Settlements of Benedictine Rule	
Giustino Farnedi	25
PART I	
History and Architecture of the Franciscan Observance	29
The Franciscan Observance in Portugal. Memories and Archives	31
Maria Filomena Andrade, João Luis Inglês Fontes, Carlos Fernando Teixeira Alves	
Franciscan Observance in Italy	43
Francesco Salvestrini	
Modulation and Allegories in the Franciscan Mother-churches of Saint Francis and Saint Clare in Assisi	53
André Franz De Naeyer	
Repara domum meam. The Basilica of Santa Maria degli Angeli in Assisi as an Example of Sustainability ante litteram	65
Paolo Belardi, Valeria Menchetelli, Francesco Cotana	
The Franciscan Reconstruction of the Church of S. Fermo in Verona in the Architectural Context of the Venetian Gothic (13th-14th Centuries)	77
Angelo Passuello	
Os Sanctos Reys. Memory of the Practices around the Tombs of the Founders of Saint Clare Monastery in Vila do Conde	89
Raquel Lourenço	
Conventets in the Crown of Aragon (13th-16th Centuries)	99
Pilar Abellan Millán	

The Convent of san Francisco in Palencia. The Graphic Trace of a History in Constant Change	109
Victor-Antonio Lafuente Sánchez, Daniel López Bragado, Alejandra Duarte Montes	
Affinities between the Third Orden Regular of Saint Francis of Penance and the Franciscan Observance. The Monastery of Santa Catalina of Montefaro (Galicia, Spain)	121
Maria Luz Ríos Rodríguez, Maria Dolores Fraga Sampedro	
Re-narrating Cultural Heritage identity. The Church of the Nativity in ‘Trattato delle piante et imagini de i sacri edifici di Terrasanta’ of Bernardino Amico and Digital history-making Representation	135
Massimiliano Savorra, Silvia La Placa	
Three Cloisters, two Churches and a Tower. From Colegio de Misiones de San Joaquín to Convent of San Francisco in Cali, Colombia (1751-2010)	149
Erik Abdel Figueroa Pereira, Costanza Cobo Fray	
Church and Convent of San Francisco in Cartagena de Indias. Its Evolutionary Process over Time	159
Ricardo Alberto Zabaleta Puello	
The Franciscan ensemble in São Paulo. Convent and Churches	167
Beatriz Piccolotto Siqueira Bueno, Luiz Guilherme de Souza Piagentini, Luciano Migliaccio, Renata Maria de Almeida Martins, Regina Helena Vieira Santos	
PART II	
Digital Survey and Documentation of Cultural Heritage	179
Franciscan Landscapes: Recording and Monitoring European Religious Architectural Heritage	181
Stefano Bertocci	
Digital Survey for the Interpretation of the Basilica of Santa Maria degli Angeli in Assisi. From the Porziuncola of Saint Francis to the Basilica-reliquary of Galeazzo Alessi	195
Claudia Cerbai	

History and Construction Chronology of the Convent of San Vivaldo in Montaione (FI)	207
Lorenzo Matteoli	
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)	221
Giovanni Pancani	
The Convent of San Nicola in Arischia. Survey and Knowledge	233
Stefano Brusaporci, Pamela Maiezza, Andrea Ruggieri	
Integrated Digital Survey Techniques for the Documentation of the Artistic Heritage of the Franciscan Observance: the Pictorial Cycle of the Indulgence of Porziuncola by Tiberio d'Assisi	247
Roberta Ferretti	
Igumen Rupestrian House Data	261
Carmela Crescenzi	
Survey of the State of Conservation of the Monastery of Sant Miquel d'Escornalbou in Tarragona (Spain) through Digital, Analytical and IR Techniques	271
Sofia Brizzi	
Tejeda Monastery, Garaballa (Cuenca, Spain). Testing Methodologies for Graphic Survey	283
Pablo Rodriguez-Navarro, Teresa Gil-Piqueras, Andrea Ruggieri, Ada Rueda García, Cynthia Cuahutencos Meza	
Interdisciplinary Perspective on the Post-earthquake Restoration of Monumental Religious Buildings. The Franciscan Convent of San Guillermo de Totalapan in Mexico	295
Matteo Bigongiari, Vieri Cardinali, Jacopo Vitale	
Digital documentation techniques for planning restoration works in the Basilica of Nativity	307
Sandro Parrinello, Francesca Picchio	
Index of Religious Places	321

VOLUME 2**PART III****Landscapes and Territories: New Tools and Strategies 343**

Promoting Franciscan Observance. Reformist Models in the Crown of Aragon between the Middle Ages and the Modern Time (14th-16th centuries) 345
 Maria Soler Sala, Núria Jornet Benito, Blanca Garí de Aguilera

Technological Innovation to Support Protection, Conservation and Promotion of Franciscan Observance Landscapes between Italy, Portugal and Spain Surveying using U.A.V. Instrumentation 355
 Pietro Becherini

Notes on Rest Stops along the Via Francigena 367
 Giuseppe Cosentino

New Contents on the Convents of the Franciscan Observance in Umbria (Italy): Examples from an Ongoing Research on the Historical Archival Documentation 375
 Anna Guarducci

Ecosystem Project for Silk Production and Regeneration of the Heritage of the Convent of San Francesco d'Assisi in Tursi 389
 Antonio Conte, Marianna Calia, Vanessa Tancredi

'Acquario della flora e della fauna dulcacquicola italiana'. Project for a Living Monument to Saint Francis of Assisi 401
 Giovanna Ramaccini, Monica Battistoni, Camilla Sorignani

The 'Battendiero' Convent in Taranto. A Characteristic Site of the Cappuccini Friars 413
 Marcello Scalzo

From Asis to Europe. Territorial-urban Development of the Franciscan Order 429
 F.-Javier Ostos-Prieto, Christa Reicher, José Manuel Aladro-Prieto, María Teresa Pérez-Cano

Integrated Digital Survey for the Documentation of Cultural Landscapes. The Franciscan Convent of Chelva on the 'Ruta del Agua' 439
 Federico Cioli

A Map of the Franciscan Heritage in the Territory of the State of São Paulo, Brazil Luciano Migliaccio, Renata Maria de Almeida Martins	451
Franciscan Citadel: Strategy for Convents in the Coastal Landscape of São Paulo Haroldo Gallo, Marcos Tognon, Fr. Alvaci Mendes da Luz	465
PART IV	
Dissemination, Management and Promotion of Cultural Heritage	473
Documentation as a Tool for Analysis and Dissemination of the Cultural Heritage. The Case of the Franciscan Observance in Portugal, Italy and Spain Soraya Genin, Rolando Volzone, Alexandra Paio, Filipe Brandão	475
Digital Tools to Disseminate Cultural Heritage Marc Ferrer	485
Inclusive Heritage Communication. Integrated Methodologies Crossing 3D Printing, Marketing and Communication for the Franciscan Observance Convents Michele Carucci, Rolando Volzone	495
Innovative Tools to Improve the accessibility of Cultural Heritage. The Experience of the Former Convent of the Clarisses in Lecce Monica Bercigli	505
Wooden Tabernacle Craved by the Marangoni Friars. A Project to Enhance an 'Untouchable' Heritage of the Capuchins of Abruzzo Alessandro Luigini, Giuseppe Nicastro, Daniele Frusone	515
Remote Sensing Architectural Survey Experiments for Historical Heritage: Complex of Santa Croce in Florence and the Challenges of Documentation Stefano Bertocci, Matteo Bigongiari, Gianlorenzo Dellabartola	527
Algorithmic Approaches for HBIM. The Great Cloister of the Opera di Santa Croce in Florence Pierpaolo D'Agostino, Giuseppe Antuono, Erika Elefante	539
Common Data Environment for Knowledge Management of Historic Built Heritage. The Study Case of the Pieve di Santa Maria in Arezzo Carlo Biagini, Niccolò Arrigo, Tommaso Ciardi, Pietro Matracchi	549

The Parish Church of San Leonardo in Artimino. Integrated Digital Survey Methodologies and Application Perspectives for Documentation and Virtualization of the Architectural Heritage Andrea Lumini	563
Digital Documentation for the Communication and Accessibility of Cultural Heritage Anastasia Cottini	575
Reverse Modeling Procedures from Digital Survey to 3D printing. The Case Study of the Nativity in Bethlehem Anna Dell'Amico, Hangjun Fu	587
The Use of HBIM as a Tool for Detecting the Habitability of the Franciscan Heritage Buildings. The Case of Monastery of Santa Clara de la Columna (Belalcázar, Spain) Pablo Manuel Millán-Millán, Maria Dolores Robador Gonzalez	601
Romanesque Cloisters. Ecosystems of Data at the Roots of European Culture Adriana Rossi, Sara Gonizzi Barsanti	609
The Origins of Christianity. Monastere de Saint Claire, Nazareth Michelangelo Pivetta, Marcello Verdolin	619
Exhibition Catalogue – F-ATLAS: Digital Documentation of Franciscan Landscapes in Italy, Portugal and Spain	627
Digital Documentation of Franciscan Landscapes in Italy, Portugal and Spain Exhibition Stefano Bertocci, Anastasia Cottini	629
Index of Religious Places	649

INTEGRATED DIGITAL SURVEY TECHNIQUES FOR THE DOCUMENTATION OF THE ARTISTIC HERITAGE OF THE FRANCISCAN OBSERVANCE: THE PICTORIAL CYCLE OF THE INDULGENCE OF PORZIUNCOLA BY TIBERIO D'ASSISI

Roberta Ferretti
University of Florence
roberta.ferretti@unifi.it

Abstract

The European project 'F-ATLAS – Franciscan Landscapes: Observance between Italy, Portugal and Spain' aims to develop methodologies for managing cultural heritage in the digital era. This paper focuses on the documentation and analysis of frescoes depicting the indulgence of Porziuncola by Tiberio d'Assisi in two locations: the Chapel of Roses in the Convent of San Fortunato in Montefalco (Perugia) and the Basilica di Santa Maria degli Angeli (Assisi). Integrated digital survey techniques, including laser scanning and photogrammetry, were employed to acquire metric, morphological, chromatic, and material data. This data permitted the creation of accurate digital reconstructions, enabling qualitative and quantitative analysis of the frescoes. The project highlights similarities and differences in their execution and composition, shedding light on Tiberio d'Assisi's artistic process. This paper underscores the importance of integrating advanced technologies to understand historical artworks' creation and conservation methods.

Keywords: Tiberio d'Assisi, integrated digital survey, frescoes.



Fig. 1
Chapel of Roses,
Convento di
San Fortunato,
Montefalco (PG).



1. Introduction

This work is part of the wide-ranging European project ‘F-ATLAS – Franciscan Landscapes: Observance between Italy, Portugal and Spain’ coordinated by the University of Florence with the co-participation of the University of Barcelona, the Portuguese Catholic University and the University of Lisbon (ISCTE-IUL).

The project aims to develop methodologies, protocols and tools for the management and enhancement of cultural heritage in the digital era and to define a strategy of documentation and knowledge for conservation, protection, reuse, and promotion, which consider tangible, intangible, and digital heritage (Bertocci et al., 2023). The methodology applied in the project starts from the macro-scale of investigation concerning the architectural and landscape context to a micro-scale concerning the cultural and artistic aspects. This contribution focuses on the documentation through the integrated digital survey techniques (laser-scanner and photogrammetric) for the analysis and preservation of the frescoes that constitute the pictorial cycle about the episodes of the indulgence of Porziuncola made by Tiberio d’Assisi for the Chapel of Roses in the convent of San Fortunato in Montefalco (Fig. 1) and the Basilica di Santa Maria degli Angeli in Assisi (Fig. 2). These frescoes are of great importance because they provide information about the appearance of the Sanctuary of Santa Maria degli Angeli and the events of the Franciscan order at the time of their realization. Also noteworthy is the digital survey outputs’

opposite page

Fig. 2
Chapel of Roses,
Basilica di Santa
Maria degli
Angeli, Assisi.



contribution to analyzing the techniques and methodologies Tiberio d'Assisi employed in representing scenes, adjusting them to the diverse morphology of their respective locations.

2. The pictorial cycle of the Indulgence of Porziuncola by Tiberio d'Assisi

Re-proposing in the Chapel of Roses at the Porziuncola (1516), a cycle of frescoes already painted at the Convent of San Fortunato in Montefalco (1512) must be linked not only to the instruction of pilgrims on the essential changes that were taking place in those years within the Franciscan order that would lead in 1517 to the division between minors and conventuals, decreed by Leo X with the bull *Ite Vos*. Indeed, the Indulgence of Forgiveness had become for the friars, who identified themselves with the reform initiated by Paoluccio Trinci, an identity principle to be contested with the rival Conventual friars (Lunghi, 2019). The pictorial cycle of the Indulgence of Porziuncola, painted by Tiberio d'Assisi, follows the narration of Michele de Berardi da Spello and is composed of five episodes (Figg. 3-4):

- (A) saint Francis penitent visited by the angels: this first scene shows saint Francis who, in order to flee the lure of the devil, threw himself naked among the thorns of a bush;
- (B) the angels guide saint Francis to the Porziuncola: saint Francis, holding two small bunches of red and white roses – in honour of Christ and the Virgin – is guided by the two angels in the direction of the Porziuncola;



Fig. 3
Comparison
between the first
four episodes
painted in the
Chapel of Roses
in Montefalco (on
the left) and in
Santa Maria degli
Angeli (on the
right).

A



B



C



D



opposite page

Fig. 4
Comparison
between the
episodes E
painted in the
Chapel of Roses
in Montefalco (on
the left) and in
Santa Maria degli
Angeli (on the
right).



- (C) Christ, through the intercession of the Virgin, appears to saint Francis, who has placed the two bunches of flowers on the altar of the chapel;
- (D) saint Francis requests Honorius III to approve the indulgence: Honorius III receives the white and red roses from saint Francis as a sign of the miracle that took place in Santa Maria degli Angeli;
- (E) saint Francis proclaims the indulgence at the Porziuncola: saint Francis preaches the indulgence to a crowd of pilgrims gathered in front of the Porziuncola.

To compare the two pictorial cycles, it is first necessary to describe the spaces in which they are located: the Chapel of Roses in Santa Maria degli Angeli stands on the site where, according to archive documents, a small site was identified as the cell of saint Francis. According to the studies conducted by C. Cenci, the oldest information on this chapel dates back to 1344. This small building was not involved in the demolitions due to the renovation of the Basilica ordered by Pope Pius V and entrusted to Galeazzo Alessi that began in the second half of the 16th century, probably due to its decentralised location. The chapel consists of two spaces of different sizes, covered by a lowered barrel vault and entirely frescoed by Tiberio d'Assisi. The larger one adjoins the original chapel, and the smaller one houses a liturgical altar located on a higher level and overlooks another space that, over time, has become a memorial shrine (Lunghi, 2019).

On the other hand, the Chapel of Roses in Montefalco is located on the left side of the four-sided portico preceding the entrance to the church. It is a small space covered by a low-hipped vault and entirely frescoed by Tiberio d'Assisi.

At the Porziuncola, Tiberio d'Assisi replicated the episodes already painted in Montefalco without significant variations, except for adapting the compositions to the different format of the panels, vertical in Montefalco, horizontal in Santa Maria degli Angeli. The painter also revised the reading direction of the pictorial cycle, with the one in Montefalco being read from left to right and the one in Santa Maria degli Angeli read from right to left.

In both chapels, saint Clare of Assisi and saint Elizabeth of Hungary, saint Ludwig of Toulouse and saint Anthony of Padua, saint Bonaventura of Bagnoregio and saint Bernardine of Siena are represented and arranged in the panels in pairs. On the wall behind the altar in the Chapel of the Roses in Santa Maria degli Angeli, there is a representation of saint Francis with his companions, this representation is not present in Montefalco. In both chapels, the Eternal is depicted on the vault.

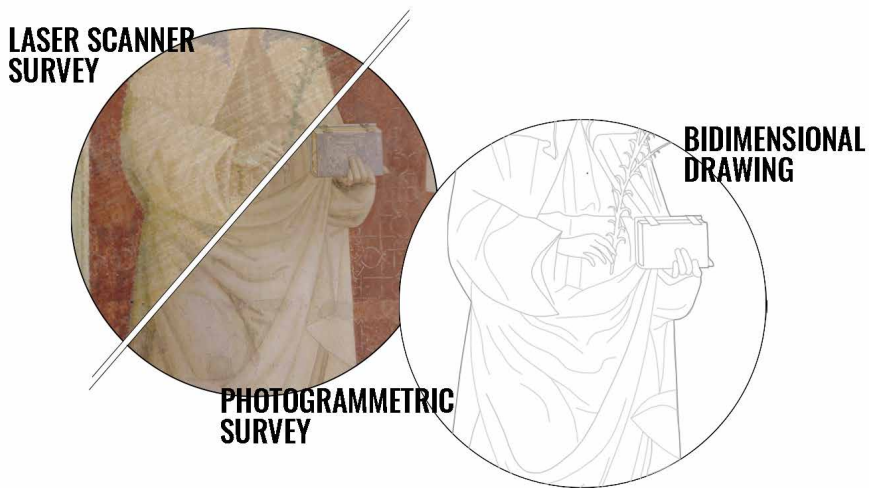
Therefore, the two pictorial representations are the only substantial differences between the last episode (E), in which saint Francis proclaims the indulgence at the Porziuncola. In realising the second pictorial cycle, it is assumed that Tiberio d'Assisi reproduced a realistic setting of the Sanctuary of Santa Maria degli Angeli when the frescoes were painted in 1512. In the episode of the proclamation of the indulgence, it is evident a further expedient used by Tiberio d'Assisi: that of reusing the same drawing used in Montefalco upside down in the arrangement of the figures, perhaps to make it more responsive to reality. From a stylistic point of view, the frescoes are perfectly consistent with Tiberio d'Assisi's painting style, which is very close to that of the great painters of his time, particularly Perugino and Pintoricchio, from whom he derived the foundations of his painting style, although he was not directly their disciple (Bordini et al., 2021).

3. Digital survey and documentation of the frescos

The digital documentation of the Chapel of Roses in Montefalco and Santa Maria degli Angeli and its decorative apparatus was conducted by integrating various techniques and technologies. These were integrated into the acquisition phase and the results, aiming to obtain 2D and 3D elaborations for multidisciplinary applications and analyses (Bertocci et al., 2019).

The integrated digital survey techniques allow the acquisition of a considerable amount of data and the implementation of verification operations for their accuracy. In particular, laser scanning techniques enable the acquisition of information regarding the metric and morphological components of the architectural object under examination. In parallel, photogrammetric surveying – using the Structure from Motion methodology

opposite page
Fig. 5
 The data of the point cloud, the texture obtained from the photogrammetric SfM survey, and a detail of the two-dimensional drawing.



– enables the acquisition of data concerning the chromatic and material components, which is crucial in documenting decorative apparatuses, especially frescoes.

Following the digital survey campaigns, to develop a reliable digital reconstruction of the decorative apparatus, a process of vectorization of the pictorial decoration and the architecture in which it is inserted was carried out, obtaining reliable two-dimensional drawings and graphical representations (Parrinello, La Placa, 2019).

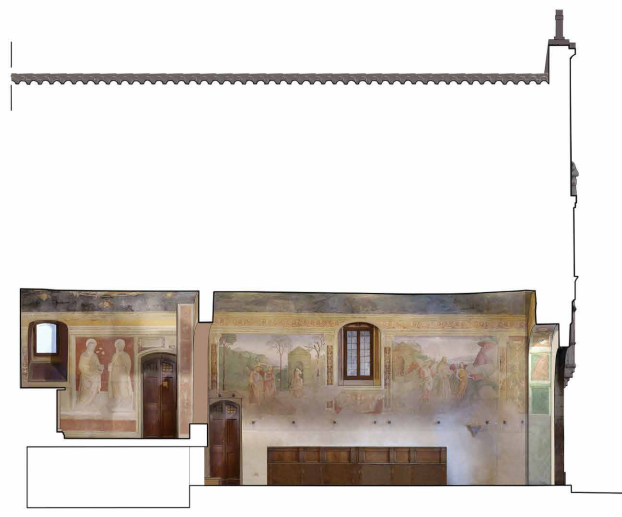
The generation of reliable elaborations from both a qualitative and quantitative perspective formed the basis for subsequent analyses and considerations on the frescoes and their methods of execution. The digital documentation was elaborated following a methodology that included a preliminary phase conducted on-site, aimed at planning the digital survey activity to facilitate the acquisition and subsequent management of data during the processing phase. The principal methodology used for survey operations was employing TLS (Terrestrial Laser Scanning) technology. For the acquisition of metric and morphological data, a Faro CAM Focus^M 70 laser scanner with phase-difference technology was used, through which a series of successive scans were performed, with a common point overlap of at least 50%. Thanks to an integrated HDR camera, it was possible to integrate chromatic data with the metric and morphological data, thus obtaining a highly descriptive point cloud. The acquired data was subsequently imported into specific point cloud management software, Leica Geosystems Cyclone, through which the main phases of filtering, registration, certification, and processing of the global point cloud were developed (Forgione et al., 2022).

opposite page
Fig. 6
Longitudinal section of the Chapel of Roses in Santa Maria degli Angeli (credits: Claudia Cerbai).

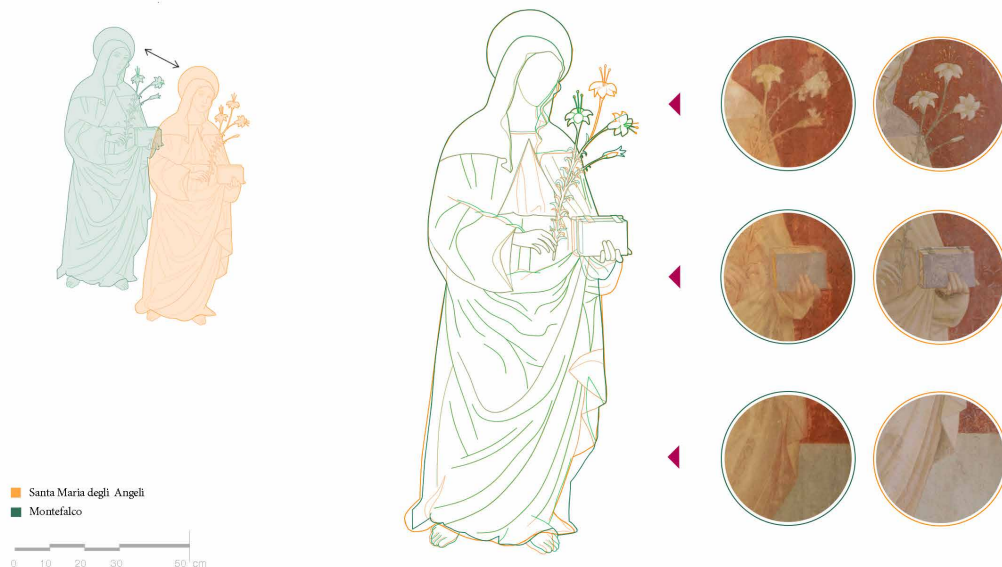
The global point cloud is obtained through a visual alignment procedure involving identifying and overlapping homologous points between adjoining scans through rigid rotations and translations. The global 3D point cloud represents the metric basis from which essential data for creating two-dimensional drawings, such as plans and sections, were extracted (Bordini et al., 2021). In parallel with the development of laser scanner surveys, detailed photogrammetric survey campaigns (SfM) of the decorative apparatus of both Chapel of Roses were carried out, aimed at integrating the metric-morphological data derived from the TLS point cloud with a product capable of representing, through mapped 3D models, information on the appearance and conservation status (Forgione et al., 2022) of the frescoes under study. Two digital cameras were used for photographic acquisitions, a Canon 1100D and a Pentax K1, equipped with an 18-55mm lens. Photographs were acquired based on the characteristics of the environment to be documented, taking into account the lighting conditions used to calibrate the camera parameters. According to the acquisition methodology, the photographs have been captured sequentially and maintaining a minimum overlap of 50% between successive photographs (Pancani et al., 2022).

Data acquisition was performed in RAW file format, which keeps colour information for later processing in a specific colour space (Pamart et al., 2017). Images were calibrated by taking a preliminary photograph and inserting a colour checker into the scene. The photographs were subsequently calibrated using Spider Checker® software. The set of balanced and colour-corrected images, saved in .jpg format, was loaded into 3D modelling software (Agisoft Metashape). Most digital processing pipeline steps, camera calibration and orientation, dense point cloud generation, polygon mesh surface reconstruction, and texture mapping were performed fully automatically. After setting up a local coordinate system, the same SfM photogrammetry software automatically generated an ortho-photomosaic from the rasterized close-range image data as a projection onto the best-fit plane (Grifoni et al., 2017). Once the high-poly textured 3D model was obtained, it was referenced and calibrated using coordinates of homologous points extrapolated from the laser scanner survey. This procedure allowed the integration of the two digital survey methodologies, resulting in mapped 3D models with a high level of reliability (Minutoli et al., 2020). By meticulously refining and discretizing the point cloud data, wireframe graphical representations of plans, elevations, and sections at a scale of 1:50 were created (Fig. 6).

These wireframe drawings were subsequently used as the basis for calibrating the orthographic images developed by exporting ortho mosaics from Agisoft Metashape



SAINT CLARE_OVERLAP HYPOTHESIS (VERIFIED)



↑
Fig. 7
 Hypothesis
 of overlap of
 the figure of
 Saint Clare and
 identification
 of the main
 differences.

software. The data obtained from the photogrammetric survey was integrated, and it became possible to carry out a detailed re-drawing of the frescoes at a scale of 1:10, enabling a comparison of the frescoes and considerations on the methodologies of their creation, as described in the following paragraph. The entirety of the acquired data and subsequent elaboration constitutes a fundamental basis for examining and interpreting the frescoes created by Tiberio d'Assisi in the Chapel of Roses in Montefalco and Santa Maria degli Angeli, considering both their morphological and chromatic aspects.

4. Analysis methodology and conclusions

This section will describe the results obtained by comparing the frescoes executed in the Chapel of the Roses in Montefalco and Santa Maria degli Angeli by Tiberio d'Assisi. It was chosen to consider two sample cases – the representation of Santa Chiara and episode B in which the angels guide saint Francis to the Porziuncola – to illustrate a methodology applicable to the entire decorative apparatus. The analyses rely on two-dimensional drawings at a scale of 1:10 made through the precise rendering of data obtained through the integration of laser scanner survey and photogrammetric survey of the internal surfaces of the two chapels. These surveys have allowed the identification of portions of decorations with overlapping profiles and have demonstrated

opposite page
Fig. 8
 First overlap
 hypothesis of the
 episode B and
 identification
 of the main
 differences.

EPISODE B_ FIRST OVERLAP HYPOTHESIS (NOT VERIFIED)



the use of the same preparatory drawings or templates to impress reference incisions and profiles on freshly applied plaster. As described in Figure 7, the overlap between the two drawings representing Santa Chiara corresponds almost perfectly. The main differences are found in the right part of the fresco, particularly concerning the drapery of the dress and the lilies that the saint holds in her hands. In the Montefalco fresco, there are three lilies, while in the one in Santa Maria degli Angeli, there are four. Given the almost total correspondence of the main lines, the hypothesis of using the same preparatory drawing can be verified.

Regarding episode B, an overlap was first made, assuming the use of a single preparatory drawing representing the three figures. As described in Figure 8, this hypothesis is not verified, as overlapping one of the three figures results in the misalignment of the other two. Therefore, we proceeded with the overlap, assuming the use of three preparatory drawings, one for each figure. As in the previous case, this hypothesis verifies the correspondence of the principal lines, especially in the overlap of drawing B.1. The main differences are recorded in the upper part, in the representation of the hair and in the wing, which in the case of Santa Maria degli Angeli is fully represented, while in the case of Montefalco is only partially represented due to the shape of the frame. As for drawing B.2, the main difference is that in the representation in Santa Maria degli Angeli the two small bunches

→
Fig. 9
 Second overlap
 hypothesis of the
 episode B and
 identification
 of the main
 differences.

EPISODE B_ SECOND OVERLAP HYPOTHESIS (VERIFIED)

B.1



B.2



B.3



■ Santa Maria degli Angeli
■ Montefalco



of red and white roses are not depicted, but the hands are in the same position. Figure B.3 almost perfectly corresponds; the only substantial difference is found in the lower part of the dress. So in this case, the second hypothesis of overlap, which suggests the use of three preparatory drawings, can be considered verified. In conclusion, with the updating of the technologies at our disposal and the integration of proven methodologies in various areas of the analysis of wall paintings, it is possible to take further steps of definite interest from the point of view of scientific research and, specifically, to clarify the operating methods and working phases (Bertocci, 2023). This contribution underscores the importance of defining an operational methodology for the study and analysis of pictorial representations and how this can serve as a crucial tool for their preservation and enhancement.

Bibliographical references

Bertocci S., Arrighetti A., Bigongiari M. 2019, *Digital survey for the archeological analysis and the enhancement of Gropina archeological site*, *Heritage*, 2 (1), pp. 848-856.

Bertocci S., Cioli F., Cottini A. 2023, *A project to enhance common identities in Europe: F-ATLAS Franciscan Landscapes*. In Balzani M., Berocci S., Maietti F., Rossato L. (eds.), *Research Innovation and Internationalisation. National and international experiences in Cultural Heritage digitalization*. Maggioli Editore, Rimini, pp. 27-42.

Bertocci S. 2023, *Le prospettive architettoniche dei Natali fra Piacenza e Pontremoli*, in Bertocci S., Còccioli Mastroviti A., Farneti F. (eds) *Un meraviglioso artificio. Architettura e grande decorazione in età barocca a Pontremoli*. Altalineia, Firenze.

Bordini E., Brizzi S., Ferretti R. 2021, *Analisi preliminari per la documentazione del Santuario del Beato Antonio Vici a Stroncone: il contributo del rilievo digitale e della termografia*, in Bellanca C., Mora Alonso-Muñozerro S. (eds), *atti del IX convegno Internazionale ReUso – Roma 1-3 Dicembre 2021*. Artemide Editore, Roma, pp 382-393.

Dizionario Bibliografico degli Italiani 2019, Tiberio d'Assisi, vol. 95, Istituto dell'Enciclopedia Treccani, Roma, pp 611-615.

Forgione A., Arrighetti A., Lumini A., Brusaporci S. 2022, *La cattedrale di San Massimo di Forcona (AQ). Primi dati dalla lettura archeologica delle architetture*, *Archeologia dell'Architettura* XXVIII, pp. 189-216.

Grifoni E., Gargano M., Melada J., Interlenghi M., Castiglioni I., Romano Gosetti di Sturmeck S., Ludwig N. 2022, *Documenting Cultural Heritage in very hostile fruition contexts: the synoptic visualization of Giotto's frescoes by Multispectral and 3D close-range imaging*, *Journal of Physics: Conference Series*, 2204.

Lunghi E. 2019, *Immagini degli Spirituali. Il significato delle immagini nelle chiese francescane di Assisi*. Il Formichiere, Foligno, pp. 227-232.

Minutoli G., Lumini A., Clausi G. 2020, *La Cappella del Santo Sepolcro a Orgia: analisi dell'edificio e progetto di restauro di un inedito modello del Santo Sepolcro di Gerusalemme*. *Restauro Archeologico*, 28(1), pp. 38–57.

Nessi S. 202, *Tiberio d'Assisi*. Accademia delle Belle Arti, Perugia.

Pancani G., Bigongiari M. 2022, *The aerial photogrammetric survey for the documentation of the Cultural Heritage: The Verruca Fortress on the pisan mountains*, D-SITE Drones – Systems of Information on cultural heritage for a spatial and social investigation, vol. 2. Pavia University Press, Pavia.

Pamart A., Guillon O., Faraci S., Gattet E., Genovis M., Vallet J.M., De Luca L. 2017, *Multispectral photogrammetric data acquisition and processing for wall paintings studies*. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-2/W3, 3D Virtual Reconstruction and Visualization of Complex Architectures, 1-3 March 2017, Nafplio, Greece, pp. 559-566.

Parrinello S., La Placa S. 2019, *Vectorialization practices of the image drawing of the floor mosaics of the Basilica of Nativity in Bethlehem*. *Scires-IT*, vol 9, Issue 2.



Finito di stampare da
Rubbettino print | Soveria Mannelli (CZ)
per conto di **didapress**
Dipartimento di Architettura
Università degli Studi di Firenze
2024

The volumes present contributions from the International F-ATLAS Conference, promoted within the European project “F-ATLAS – Franciscan Landscapes: The Observance between Italy, Portugal and Spain”, funded in 2020 by the JPIC 2019 Conservation, Protection and Use Call. The Conference brought together experts from various disciplines, including history, architecture, geography, digital humanities, and computer science, creating a rich and comprehensive interdisciplinary dialogue. Participants from renowned international universities offered unique insights into the Franciscan Observance and its impact on European Cultural Heritage. The contributions examined the past and sparked discussions on the future of documenting and safeguarding religious heritage.

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.

Federico Cioli is a Research Fellow and Contract Professor at the Department of Architecture of the University of Florence. His research addresses historical architecture, urban centres, and digital documentation, focusing on the relationship between tangible and intangible cultural heritage. His main activity includes research on the historical and traditional trade in Florence’s UNESCO city centre and the cultural heritage of historical theatres.

ISBN 978-88-3338-222-7



9 788833 382227