Sandro Parrinello, Darka Bilić
Josip Pavić, Alberto Pettineo

Edited by

VENETIAN BORDERSCAPES

Digital documentation for the study of settlement patterns in the fortified landscapes of the Central Dalmatia



PROSPETTIVE MULTIPLE
STUDI DI INGEGNERIA
ARCHITETTURA E ARTE

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This volume contains the proceedings of the Study Day dedicated to the project "Venetian Borderscapes – Digital Documentation for the Study of Settlement Patterns in the Fortified Landscapes of Central Dalmatia", held in Verona at the Porta Palio monument on September 6, 2026. The research activities presented in this collection are part of the project supported by the Veneto Region and coordinated by the University of Florence. The project focuses on the digital documentation and analysis of historic fortified settlements along the Dalmatian coast. On the same day, an exhibition was opened at Porta Palio, featuring graphic and multimedia displays illustrating the research outcomes and the documentation activities carried out in the field.

The project 'Venetian Borderscapes: Digital Documentation for the Study of Settlement Patterns in the Fortified Landscapes of Central Dalmatia' and its publication are part of the 'Project co-funded by the Veneto Region in accordance with L.R. n. 39/2019.'

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TABLE OF CONTENTS

FOREWORD

A Multidisciplinary Research Approach to Documenting and Reading Fortified Settlements of Central Dalmatia
Sandro Parrinello, Darka Bilić, Josip Pavić, Alberto Pettineo 8

INTRODUCTION

Digital Documentation and Interpretive Models for the Valorisation of Fortified Heritage
Sandro Parrinello, Alberto Pettineo 15

FORTIFIED SITES BETWEEN HISTORY AND DIGITAL DOCUMENTATION

Seget Donji: A Fortified Coastal Settlement
Darka Bilić, Alberto Pettineo 27

Defence of the southeastern part of Contado di Zara - Pakostane, Sv. Filip i Jakov, Turanj
Ivo Glavas 43

The Fortified Settlement of Vodice
Karla Papeš, Vito Rosalia 57

The Citadel and Tower in Marina
Marijeta Babin, Dario Jonka 71

Kaštel Gomilica between History and Representation: Multi-Scale 3D Printing for Reading Fortified Heritage
Dora Horvat, Giulio Ribelli 87

Kaštel Cippico and Kaštel Stafileo: From Point Cloud Machine Learning to HBIM of Historical Stratifications
Mariangela Carissimo, Luca Chiavacci 105

EXHIBITION & PHOTOGALLERY

The Design of an Exhibition for Fortified Heritage between Italy and Croatia 122

Exhibition Panels 126

Photographic Gallery 150

CREDITS

156

FOREWORD



A MULTIDISCIPLINARY RESEARCH APPROACH TO DOCUMENT AND READING FORTIFIED SETTLEMENTS IN CENTRAL DALMATIA

The research project "Venetian Borderscapes – Digital Documentation for the Study of Settlement Patterns in the Fortified Landscapes of Central Dalmatia" was developed with the aim of promoting the knowledge, preservation, and enhancement of fortified settlements along the Dalmatian coast. Building upon the experience of the previous "3D SEBENICO – 3D Survey of Built Venetian Historic Fortresses" project, the initiative represents a further stage in a long-term research programme dedicated to the documentation and interpretation of the historical and architectural heritage of the *Stato da Mar*. The project has strengthened an international research network bringing together universities, research institutes, and cultural institutions to develop interdisciplinary approaches to the study of fortified settlements, with particular attention to the relationships between architectural structures, urban development, and the surrounding landscape.

The research has focused on the fortified settlements that developed along the central Dalmatian coast between the fifteenth and seventeenth centuries, with particular attention to the historical settlements of Kaštela and neighbouring coastal centres. These settlements, often characterised by a principal fortified residence associated with an enclosed urban nucleus, emerged within a complex political and territorial context marked by the expansion of Ottoman power and the need to protect rural populations. Their architectural configurations reflect the interaction between defensive requirements, residential functions, and processes of urban development, revealing the importance of these fortified nuclei in the organisation of the coastal territory. Although subsequent transformations and contemporary urban expansion have partially altered their original configurations, their historical structures remain recognisable through surviving architectural elements, urban layouts, and the relationships between buildings and the surrounding landscape.

The activities promoted within the project have fostered interaction between historical research, architectural documentation, and digital representation, involving researchers and young scholars in a multidisciplinary process of investigation. Through the integration of architectural surveys, archival research, and morphological analysis, drawing has played a central role as an instrument for interpreting the identity and spatial organisation of these settlements. In its digital form, drawing has acquired particular significance in the construction of documentary and interpretative frameworks, integrating three-dimensional models, historical sources, and graphic representations to communicate the architectural and urban characteristics of the sites.

Digital documentation has therefore constituted a fundamental component of the research, supporting both the analysis of individual architectural structures

and the interpretation of broader settlement systems. The historical transformations affecting these fortified settlements, together with the progressive incorporation of their defensive structures into contemporary urban fabrics, have made the reconstruction of their original configurations particularly challenging. In this context, digital surveying technologies provide accurate metric documentation of the existing built heritage, while enabling comparative investigations into architectural forms, construction techniques, and spatial relationships. The integration of laser scanning, terrestrial and UAV photogrammetry, and three-dimensional modelling has supported the development of digital datasets capable of describing these settlements at different scales, from individual architectural elements to the organisation of fortified urban nuclei.

The combination of digital methodologies with traditional historiographical research has also provided an opportunity to examine the historical processes that shaped the development of these settlements. The comparison between archival documentation, historical cartography, and the material evidence recorded through architectural surveys makes it possible to identify recurring settlement patterns, recognise successive transformations, and investigate the relationships between fortified residences and the urban structures that developed around them. This approach considers the fortified settlements not merely as isolated military constructions, but as complex architectural and urban organisms whose configurations express the changing defensive, economic, and social conditions of the Dalmatian coast during the period of Venetian rule.

The project has also contributed to education and scientific training by involving young researchers in the application of advanced documentation methodologies. Field investigations have provided opportunities to combine theoretical knowledge with practical experience in the acquisition, processing, and interpretation of architectural data. The resulting point clouds, three-dimensional models, and graphic elaborations constitute metrically reliable records that support the study of the architectural characteristics and conservation conditions of the investigated sites. At the same time, these digital resources establish a documentary basis for future research, conservation activities, and the development of new forms of cultural interpretation.

The research activities were organised through successive phases, beginning with the identification and historical analysis of fortified settlements along the central Dalmatian coast, particularly in the territories between Split, Trogir, Šibenik, and Zadar. Field investigations concentrated on a selection of significant sites, including Kaštel Stari, Kaštel Novi, Kaštel Štafilić, Kaštel Gomilica, Seget Donji, and Marina, whose architectural and urban configurations provide different examples of

the development of fortified settlements. The surveys were accompanied by archival investigations and the analysis of historical sources, contributing to a broader understanding of the relationships between individual buildings, defensive boundaries, and settlement patterns.

The digital documentation process involved the integrated use of laser scanning and photogrammetric techniques, combining terrestrial acquisitions with aerial surveys to record the architectural and urban characteristics of the selected sites. The processing and integration of the acquired data enabled the production of high-resolution point clouds and three-dimensional models, from which plans, elevations, sections, and other analytical representations were developed. Particular attention was given to the interpretation of architectural geometries and the preparation of digital models for physical prototyping. Through processes of geometric reconstruction, mesh optimisation, and additive manufacturing, selected architectural structures were translated into three-dimensional printed models, providing tangible instruments for the comparison and communication of their formal and spatial characteristics.

A significant aspect of the project has been the relationship between the investigated settlements and the communities that continue to inhabit them. Unlike isolated defensive structures, many of these fortified nuclei remain closely integrated into contemporary urban environments, where historical architecture coexists with successive transformations and new functions. Their documentation therefore contributes not only to the preservation of architectural knowledge, but also to the recognition of the cultural identities associated with these places. The project has sought to enhance awareness of the historical connections between the two shores of the Adriatic, highlighting the shared architectural traditions and territorial relationships that developed during the centuries of Venetian presence.

The collaboration between Italian and Croatian institutions has played a central role in the development of the research. The activities were coordinated by the Department of Architecture of the University of Florence in partnership with the Institute of Art History in Zagreb, with the participation of the Fortress of Culture Šibenik and Società Mutuo Soccorso Porta Palio in Verona. This cooperation has encouraged the exchange of scientific expertise and methodological approaches, bringing together knowledge in architectural surveying, digital modelling, historical research, and heritage communication. The interdisciplinary character of the collaboration has been particularly important in addressing the complexity of the fortified settlements, whose study requires the integration of architectural, historical, and territorial perspectives.

The results of the research have also been developed into an exhibition entitled "Marks on the Frontier – Settlements and Landscape of Venetian Dalmatia", conceived as an opportunity to communicate the historical and architectural significance of the documented sites to a wider audience. The exhibition, presented at Porta Palio in Verona in September 2026 and scheduled to continue at Barone Fortress in Šibenik in October 2026, brings together historical materials, architectural drawings, digital reconstructions, three-dimensional models, and physical prototypes. These different forms of representation contribute to a narrative that connects the history of the fortified settlements with the methodologies employed in their documentation and interpretation.

Particular importance has been given to the communicative potential of digital and physical representations. The integration of graphic elaborations, three-dimensional models, and multimedia materials provides opportunities to explore architectural configurations that are no longer immediately recognisable within contemporary urban environments. By presenting the results of the surveys alongside historical and interpretative documentation, the project encourages an understanding of the transformations that have affected these settlements over time. In this sense, digital archives are conceived not only as repositories of information, but also as instruments for constructing new narratives about the architectural heritage of the Dalmatian coast.

The investigations presented in this volume bring together the outcomes of historical research, architectural documentation, and digital representation, offering an interdisciplinary perspective on the fortified settlement systems of Central Dalmatia. The resulting documentary resources provide a basis for further studies into the architectural and urban development of these settlements, while contributing to the broader understanding of the territorial organisation of the Venetian *Stato da Mar*. Through the integration of traditional research methods and advanced digital technologies, "Venetian Borderscapes" demonstrates the potential of architectural documentation to reveal the historical relationships between built structures, settlement patterns, and cultural landscapes.

Sandro Parrinello
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Josip Pavić
Alberto Pettineo

INTRODUCTION



DIGITAL DOCUMENTATION AND INTERPRETIVE MODELS FOR THE VALORISATION OF FORTIFIED HERITAGE

SANDRO PARRINELLO, ALBERTO PETTINEO
University of Florence

Along the Dalmatian coast, between centres such as Zadar, Šibenik and Split, once nodes on the Serenissima's trading routes, the small fortified settlements examined in this study give the impression of having changed very little. Their surviving fabric preserves the traces of an organisation in which the protection of communities was closely bound to dwelling and agricultural labour. This apparent absence of change in the settlements is nevertheless challenged by the evidence of building works currently under way, most of them involving the construction of new tourist accommodation. The process of development, which also extends into the surrounding landscape, makes it increasingly difficult to recognise the characteristics of the historic fortified structures within the contemporary urban fabric.

If texts and archival documents 'do not speak unless one knows how to question them',[1] the same is true of architecture itself. Structures built to defend a community often preserve information that no one had intended to pass on to posterity and that can be 'read' in the way their masonry was laid and assembled.

In documenting these structures, research in turn produces a deliberate form of testimony through drawings and models that inevitably fix an interpretation of the architecture at a particular moment in its history, transforming the observations gathered during the investigation into a visual narrative[2].

Temporal discontinuity is inherent both in surveying and in the documentation available, yet the continuous time of history necessarily encompasses changes that this documentation has failed to record. The distinction between the phases through which that history is reconstructed therefore constitutes an interpretative choice, to be examined in relation to the duration of the processes under observation[3].

A similar selection concerns the architecture through which this history is told. In accounts of the fortified heritage of the *Stato da Mar*, Venice's maritime dominions, the great fortresses and principal trading ports occupy a central position, reflecting the military and political affairs of the Republic of Venice. Smaller settlements and their defensive systems more often

[1] Marc Bloch, *Apologia della storia o Mestiere di storico*, ed. Étienne Bloch, trans. Giuseppe Gouthier (Turin: Einaudi, digital edition, copyright 1998 and 2009), chap. II, § 2. Quotation translated from the Italian edition cited here.

[2] Bloch, *Apologia*, chap. II, § 2, PDF pp. 111–15; Sandro Parrinello, "Disegnare le strutture militari nell'era digitale. Lo sviluppo di un percorso conoscitivo," in *Dalmazia e Montenegro. Le fortificazioni venete nel bacino del Mediterraneo orientale*, ed. Sandro Parrinello and Francesca Picchio (Pavia: Pavia University Press, 2019), 22–24.

[3] On continuity, change and periodisation, see Jacques Le Goff, *Il tempo continuo della storia*, trans. David Scaffei (Rome–Bari: Laterza, digital

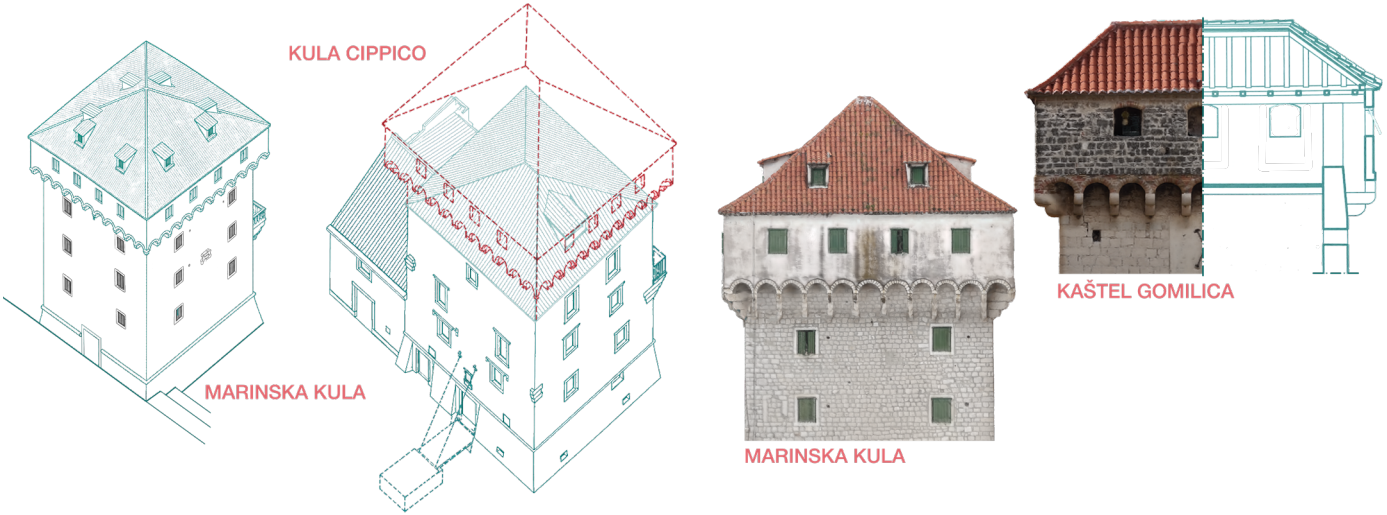


Fig. 1: Fortified towers in central Dalmatia. Comparative axonometric drawings and elevation studies of Marina Tower, the Cippico Tower and the entrance tower of Kaštilac at Kaštel Gomilica. The interpretive drawings of the Cippico Tower and Kaštilac are reworked from the interpretations published by Katja Marasović in *Kaštelanski kašteli* (2025).

remain in the background. Their history has to be reconstructed through transformations associated with everyday life, which are less readily traced in the major military chronicles[4].

It is this heritage, misleadingly described as 'minor', that the *Venetian Borderscapes* project addresses through an investigation of small fortified settlements and the relationships between their constituent buildings and structures. The area under study extends from Kaštela Bay, between Split and Trogir, to the settlements of Seget, Marina and Vodice, along the coast towards Šibenik. Within these settlements, the seigneurial residence, the fortified enclosure and the houses formed part of the same history of settlement development, in which the sea played a determining role. Several *kaštel* stood on rocky islets or immediately beside the shore, with access from the mainland controlled by bridges. The water contributed to their defence while maintaining a connection with other coastal centres, enabling supplies to arrive and providing a possible means of escape in the event of an attack. The castle thus protected a community whose livelihood depended on cultivating the land behind it, and whose continued presence also relied on access to the sea[5]. The progressive alteration of the coastline, which began in the last century and has become markedly more pronounced with the construction of quays, promenades and roads for vehicular traffic, has incorporated many of these structures into the mainland. As a result, the relationship with the water that had determined the settlement's position and configuration has become less readily recognisable.

edition, October 2014), "Prefazione," PDF pp. 5–6.

[4] Lucien Febvre, "Preface," in Marc Bloch, *French Rural History: An Essay on Its Basic Characteristics*, trans. Janet Sondheimer (Berkeley and Los Angeles: University of California Press, 1970), xix–xxi; Vanja Kovačić, "Città fortificate in Dalmazia: modelli di difesa del territorio e dell'ambito insulare dal XVI al XVII secolo," in *L'architettura militare di Venezia in terraferma e in Adriatico fra XVI e XVII secolo*, ed. Francesco Paolo Fiore (Florence: Olschki, 2014), 267–68.

[5] Kovačić, "Città fortificate in Dalmazia," 267–69.

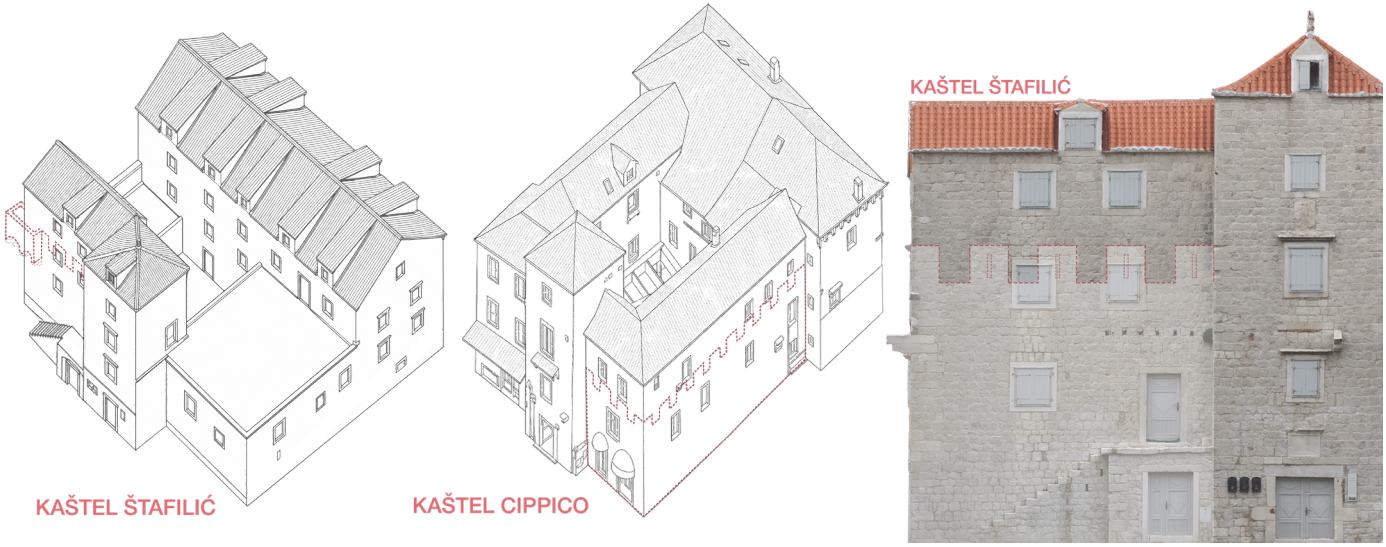


Fig. 2: Kaštel Štafilić and Kaštel Cippico. Axonometric drawings and an elevation study highlighting traces of former defensive arrangements within the present buildings. The interpretive drawings of Kaštel Štafilić are reworked from the interpretations published by Katja Marasović in *Kaštelanski kašteli* (2025).

The difficulty of discerning these relationships today heightens the sense of heritage loss and makes documentation an urgent task. A record is needed that can preserve evidence of these structures, at least in digital form, before further alterations and replacements compromise their architectural characteristics still further.

The present project continues a programme of research devoted to documenting the fortifications of the *Stato da Mar*, begun in 2019 with the study of Venetian fortifications in Dalmatia and Montenegro and developed in 2023 through *3DSebenico: 3D Survey of Built Venetian Historic Fortresses*[6]. Those investigations had concentrated predominantly on the larger centres and principal fortresses of the Republic of Venice. The study of the *kaštel* now shifts attention towards smaller settlements, examining in greater depth the relationship between defensive structures and the formation of inhabited places.

Survey campaigns devoted to the larger fortifications had also provided opportunities to observe the smaller settlements now being studied by *Venetian Borderscapes*. Returning to these places three or four years later made it possible to identify substantial transformations that had taken place before systematic surveying of the settlements began. The continuity of research along the Dalmatian coast has thus brought into focus the speed at which this heritage is being altered.

The impression of an absence of change thus gives way to the image that 'our villages wear an ancient dress, but one that has often been made over'[7]. Once their defensive function had come to an end, these

[6] *Venetian Borderscapes: Digital Documentation for the Study of Settlement Patterns in the Fortified Landscapes of the Central Dalmatia*, research project, Annex B to Decree no. 16 of 24 February 2025, PDF pp. 6–8, 16; Sandro Parrinello, "Metodi e risultati dell'analisi della ricerca per la documentazione digitale a Sebenico," in *3D Sebenico: 3D Survey of Built Venetian Historic Fortresses*, ed. Sandro Parrinello, Ludovica Galeazzo, Darka Bilić, Francesca Picchio and Josip Pavić (Pavia: Pavia University Press, 2024), 77–85.

[7] Marc Bloch, *French Rural History: An Essay on Its Basic Characteristics*, trans. Janet Sondheimer (Berkeley and Los Angeles: University of California Press, 1970).

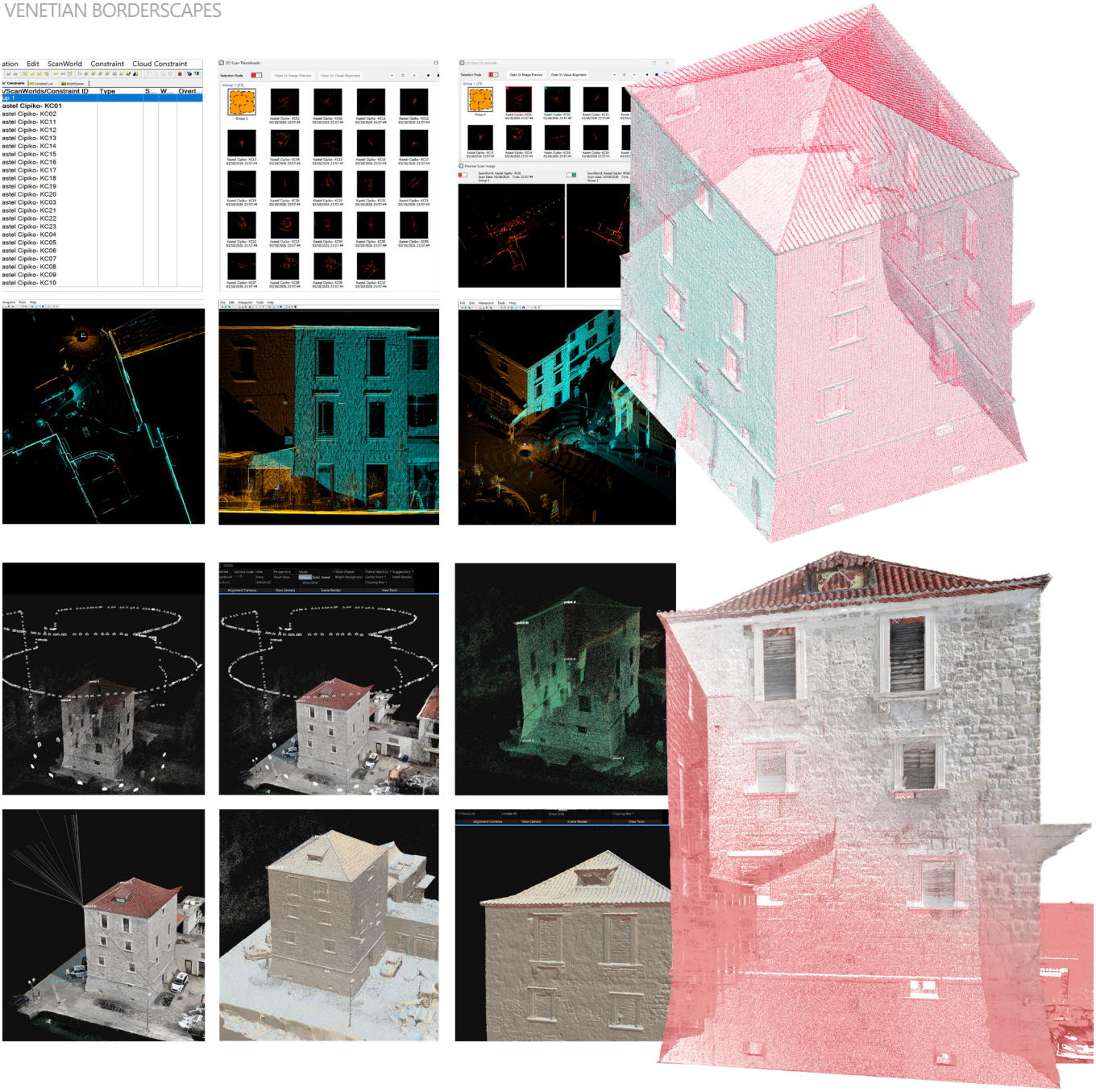


Fig. 3: Registration and alignment of laser scans and photogrammetric imagery through established processing workflows, bringing the acquired datasets into a common spatial reference system for the integrated documentation of the architectural structures.

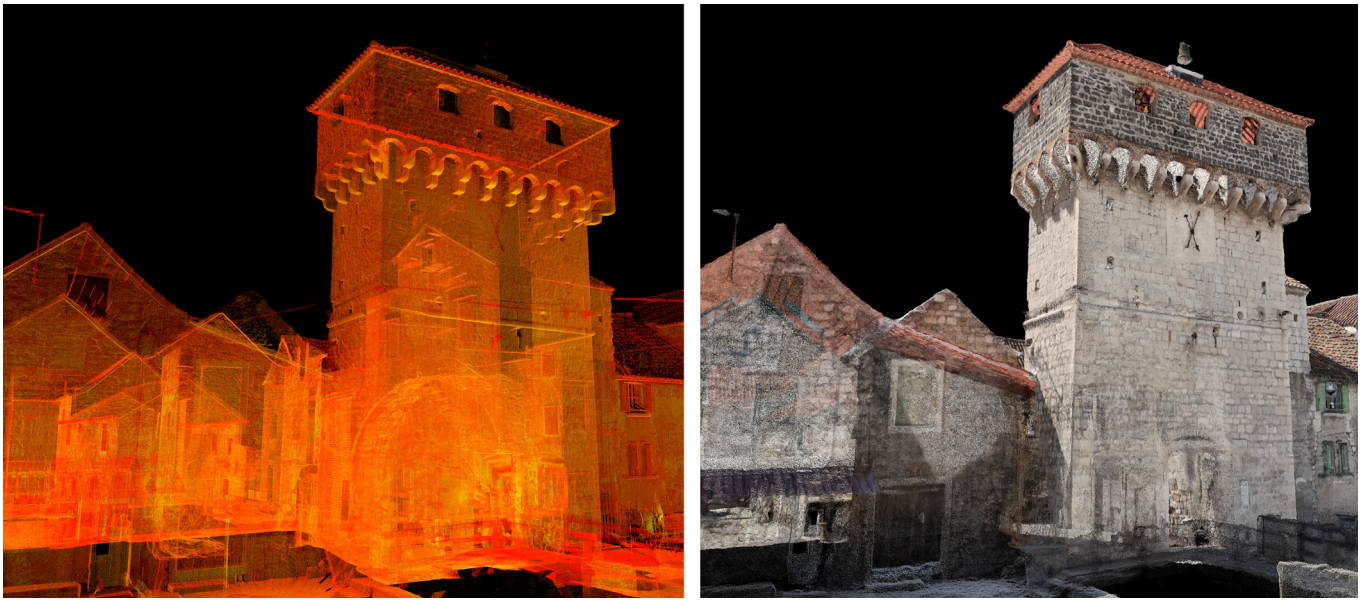


Fig. 4: Kaštel Gomilica. False-colour and colour views of the Kaštilac entrance tower. Integrated laser scanning and photogrammetry document the masonry construction and the material character of the architectural surfaces.

buildings continued to be inhabited and adapted to new requirements. Their continued presence within the contemporary urban fabric can therefore coincide with the erasure of the material traces of construction that bear witness to their history.

Documentation gathers and interprets these traces, entrusting digital archives with the observations of the built fabric and the reasoning that underpins the interpretations put forward by the research[8].

Extending the investigation across several coastal settlements requires the materials gathered in different places and under different conditions to be made comparable. This issue arises from the outset of field acquisition campaigns: the distribution of surviving structures within each settlement has to be documented while also capturing the detail required to study individual buildings. The choice of survey scales and techniques therefore depends on the questions addressed to each site and on the possibility of bringing the observations together within a common framework[9].

The approaches tested during the early campaigns on the fortresses of the *Stato da Mar* combined close-range architectural surveying with extensive documentation of the fortified systems. This made it possible to vary

[8] Bloch, *Apologia*, chap. II, § 2, PDF pp. 111–15; Parrinello, "Disegnare le strutture militari nell'era digitale," 22–24.

[9] On previous extensive surveys of the *Stato da Mar*, see Sandro Parrinello and Silvia La Placa, "Ricostruire la memoria dello Stato da Mar attraverso un percorso di conoscenza, documentazione e disegno," in *Connettere. Un disegno per annodare e tessere*, ed. Adriana Arena et al. (Milan: FrancoAngeli, 2020), 2535–37, 2540. On the relationship between acquisition, models and the territorial scale, see Sandro Parrinello and Francesca Picchio, "Digital Strategies to Enhance Cultural Heritage Routes: From Integrated Survey to Digital Twins of Different European Architectural Scenarios," *Drones* 7, no. 9 (2023): 576, §§ 2.2–2.3; Sandro Parrinello, "Documentare una rotta culturale tra procedure di rappresentazione e di materializzazione del paesaggio," in *Transizioni*, ed. Mirco Cannella, Alessia Garozzo and Sara Morena (Milan: FrancoAngeli, 2023), 1807, 1809–10.

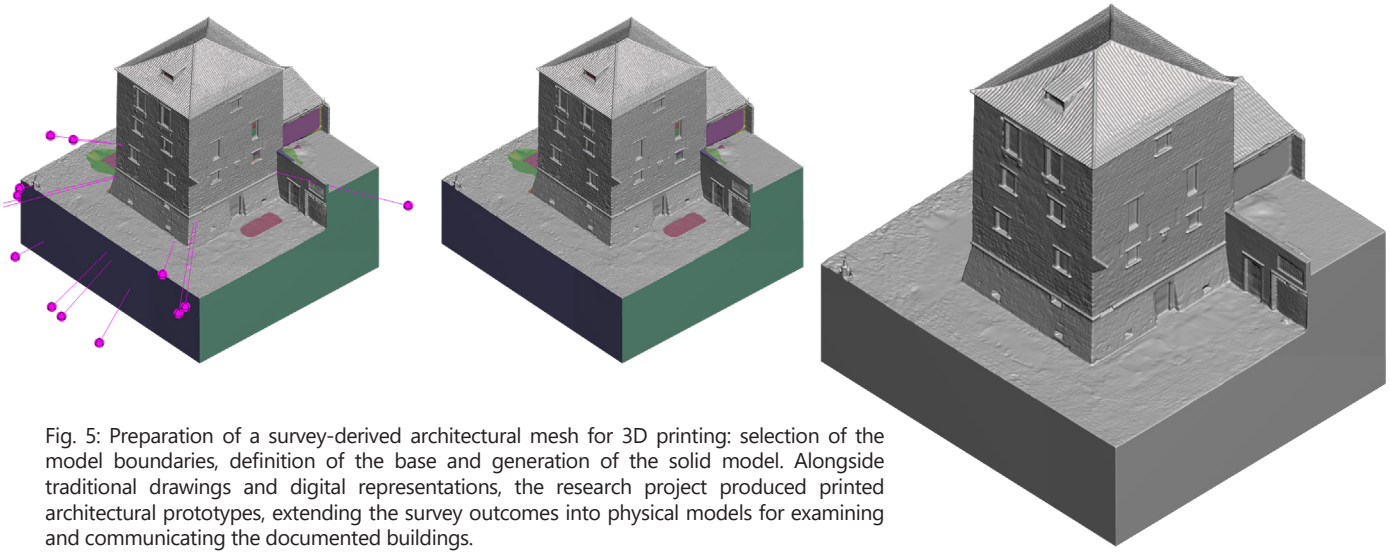


Fig. 5: Preparation of a survey-derived architectural mesh for 3D printing: selection of the model boundaries, definition of the base and generation of the solid model. Alongside traditional drawings and digital representations, the research project produced printed architectural prototypes, extending the survey outcomes into physical models for examining and communicating the documented buildings.

the level of acquisition detail according to the size of the sites and the conditions of access. The extensive use of mobile laser scanners, alongside the by then established techniques of terrestrial laser scanning and photogrammetric surveying, made the acquisition of entire urban sectors practicable, while requiring careful planning of the routes to be followed. Rapid surveying thus formed part of a strategy that connected the measurement of an individual building with an understanding of its wider context.

In the study of the *kaštel*, this strategy has been adapted to structures surviving in fragments within an inhabited fabric and to the opportunities offered by advances in survey equipment. During the documentation campaigns undertaken for the present project, faster acquisition and reductions in the weight and bulk of terrestrial laser scanners made it possible to carry out rapid surveys using scans from fixed stations. At the same time, improvements in photogrammetric processing software supported the extensive use of drone photography and more accurate geometric reconstruction of surfaces. Integration with terrestrial photogrammetry connected the documentation of the masonry with the overall configuration of the settlements, bringing the detailed acquisitions and the surveys of their wider context into the same spatial reference system.

The coverage achieved and the level of detail available nevertheless vary from one part of the surveyed area to another. These differences must remain apparent in the resulting representations, since they determine the purposes for which the acquired data can be used.

The research archive takes shape through the organisation of these materials. For each site, survey data must remain traceable to the conditions and date of acquisition, while drawings and models must retain their links with the materials from which they were derived. Historical and cartographic sources enter this structure as documents with their own provenance and chronology. The archive thus allows a representation to be traced back to the observations and sources that support it, so that its content can be checked or a different interpretation proposed. At the territorial scale, this organisation makes it possible to compare the case studies without losing the information specific

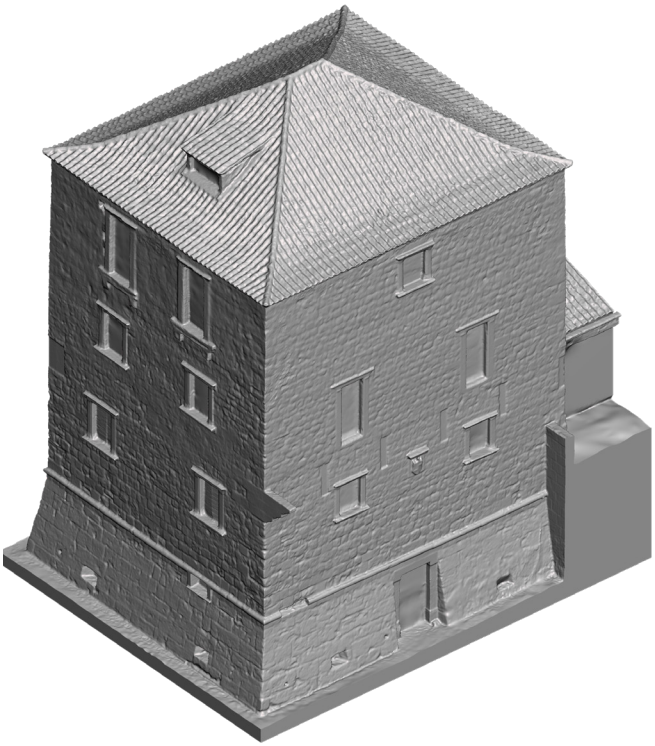


Fig. 6: Detail of the architectural mesh prepared for physical reproduction, retaining the tower's wall surfaces, openings and roof geometry.

to the history of each place[10].

Observation continues as the survey data are processed, when the investigation calls for comparisons and checks that may not have been anticipated in the field. Laser scans provide a three-dimensional metric record that can be revisited to examine the geometry of the structures and the relationships between their constituent parts. Different sections and projections can be extracted from this documentation as the research develops, while photographic images support the interpretation of materials and discontinuities in the building fabric.

In producing the drawings, these data are selected and organised in relation to the questions emerging from the investigation. Drawing makes an architectural interpretation explicit through the choice of section planes, scales and elements to be brought into relation with one another. It thereby allows transformations of the built fabric to be traced and configurations to be compared that direct observation, constrained by access and the viewpoints available, reveals only in fragments. Representation becomes part of the reasoning through which the material evidence is interpreted.

This interpretation can be developed through the construction of a knowledge model, linking geometry with information about the building's components and their history. In buildings that have undergone alterations, apparently unified parts may belong to different phases, while the same structure may have served several functions over time. The organisation of the model allows these overlaps to be described and chronological attributions to be linked to the sources that support them. The basis of the hypotheses and the aspects that remain uncertain can thus be kept explicit, allowing the interpretation to be revised as new evidence comes to light[11].

Building information modelling for heritage (HBIM) and ontologies can develop this organisation through a shared vocabulary and explicit relationships between components[12]. Incorporating criteria for assessing the

[10] Parrinello and Picchio, "Digital Strategies," §§ 2.2–2.3; Parrinello, "Documentare una rotta culturale," 1807, 1809–10.

[11] Fabrizio I. Apollonio, *Architettura in 3D. Modelli digitali per i sistemi cognitivi* (Milan: Bruno Mondadori, 2012), chap. 2, consulted through the working transcripts "Trascrizioni e commenti II"; Livio De Luca, Philippe Véron and Michel Florenzano, "A Generic Formalism for the Semantic Modeling and Representation of Architectural Elements," *The Visual Computer* 23 (2007): 181–82; Livio De Luca, Chawee Busayarat, Chiara Stefani, Philippe Véron and Michel Florenzano, "A Semantic-Based Platform for the Digital Analysis of Architectural Heritage," *Computers & Graphics* 35, no. 2 (2011): 227–41, §§ 3.1–3.3 and 5.3.

[12] Alberto Pettineo and Sandro Parrinello, "Architectural Heritage through HBIM and Ontologies: A Formal Analysis of Sant'Andrea Fortress Portal in Venice," *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XLVIII-5/W3-2025 (2025): 84–86.

reliability of reconstructions provides a further basis for the future development of information models of the *kaštel*[13].

Comparing survey evidence with documentary sources becomes decisive when reconstructing configurations that no longer survive. Three-dimensional representation can give preserved structures and hypothetical additions the same visual prominence, reducing the apparent distinction between what can be observed and what has been proposed through research. The representations must therefore make both the basis of the reconstructions and the gaps in the documentation identifiable. In this way, the model retains its value as an interpretation that can be scrutinised and revised when new evidence emerges[14].

Digital memory rests on the possibility of preserving and transmitting this body of data, processed materials and interpretations. Its value depends on their potential for reuse: a point cloud or model must remain intelligible to researchers who were not involved in the original acquisition. Preserving the provenance of the materials and documenting the operations carried out allows other scholars to resume and develop the work. When transformations of a place erase a previously recorded condition, the archive still offers the possibility of observing it and of asking questions different from those that originally guided the survey[15].

The exhibition and publication give this body of research a form through which it can reach the public. On the exhibition panels, the juxtaposition of plans and three-dimensional representations makes it possible to recognise differences that are less immediately apparent when visiting the individual sites. The 3D-printed models translate the digital work into objects that can be viewed from several positions, their geometry adapted to the scale and requirements of physical reproduction. Preserving the original acquisitions and intermediate processing stages allows these forms of public communication to be distinguished from the documentation used in the research itself.

The contributions collected in this volume examine the individual case studies within this shared perspective. Bringing them together makes it possible to discuss the interpretations arising from the documentation and to assess their significance in relation to the history of the places concerned. Heritage valorisation is bound to the possibility of returning this knowledge to those who inhabit these settlements and those who work on their buildings. Making what survives today recognisable, and the transformations that produced it understandable, provides a basis for taking its value into account in future decisions. Documentation thus acquires a life beyond the duration of the project, preserving access to the sources through which this knowledge can be further developed and reconsidered.

[13] Sandro Parrinello and Alberto Pettineo, "Traditional Architectures Along the Cultural Route of James I of Aragon in the Province of Valencia: Leveraging Laser Scanning and BIM for Heritage Management," *Materials Research Proceedings* 40 (2024): 354–56.

[14] De Luca et al., "A Semantic-Based Platform," § 5.3, figs. 9–10; *The London Charter for the Computer-Based Visualisation of Cultural Heritage*, version 2.1, 7 February 2009, §§ 4.4–4.6, https://londoncharter.org/principles/documentation.html.

[15] Sandro Parrinello, "Preserving Memory through Image: Landscapes and Digital Databases for Documentation," in *Digital & Documentation: Databases and Models for the Enhancement of Heritage*, ed. Sandro Parrinello (Pavia: Pavia University Press, 2019), 29–33; *The London Charter*, principle 5, https://londoncharter.org/principles.html.

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FORTIFIED SITES BETWEEN HISTORY AND DIGITAL DOCUMENTATION



SEGET DONJI: A FORTIFIED COASTAL SETTLEMENT

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Historical Context and Settlement Analysis

The formation of the fortified settlement of Seget Donji was part of a broader process of territorial and defensive reorganisation that progressively affected the Dalmatian coast under the rule of the Republic of Venice between the second half of the fifteenth century and the sixteenth century. The Ottoman advance towards the Adriatic coast, accompanied by growing instability in the hinterland, made it necessary to extend military protection beyond the walls of the principal towns to encompass the countryside, agricultural estates and rural communities on which a substantial part of the urban economy depended. Territorial defence thus became a dispersed system of isolated towers, fortified residences and protected settlements, whose distribution responded both to security requirements and to the need to ensure the continuity of agricultural production.

The earliest manifestations of this transformation can be traced to the second half of the fifteenth century, when the Ottoman conquest of Bosnia in 1463 heightened perceptions of insecurity along the land frontier of the Venetian territories. Before the coastal settlement was founded, an isolated defensive tower is documented in the agricultural plain of Seget. It had a quadrangular plan, a battered base and a crowning structure supported on stone corbels. At the beginning of the sixteenth century, the tower belonged to the Trogir citizen Jerolim Testa; in 1516 it passed to the Statileo family, who recorded their ownership in an inscription and displayed their coat of arms. The tower bears witness to a phase in which the protection of property and inhabitants still relied on individual strongpoints, before the spread of fortified settlement models introduced a more complex organisation of inhabited space.

The foundation of present-day Seget Donji dates to the second half of the sixteenth century and has a precise documentary reference in the privilege granted on 13 January 1564 by Agostino Bembo, Count and Captain of Trogir (Traù), to Giacomo Rotondo, a citizen of Trogir, clerk of the fiscal chamber and native of Ravenna. Through this grant, Rotondo obtained permission to build, at his own expense, a fortified complex in the Campo Piccolo, at Conazvine, on a site known as Murvica. The proposed works comprised a masonry tower standing in the sea and connected to the mainland by a drawbridge, together with a square fortified enclosure, designated in the document as a *revelinum*, measuring twenty-four paces on each side.

The reasons stated in the privilege clarify the nature of the initiative and its place within territorial defence strategies. The new structure was intended to protect Rotondo, his property and the inhabitants who would settle in the complex with his consent. The document also emphasised the absence of other towers along that stretch of the Trogir coast, indicating that the intervention



Fig. 1: S. B. Moser de Filsek, map of the Trogir area, 1763. Detail showing Seghetto, the surrounding agricultural land, the church of Santo Spirito and Castello Rosignoli. The map records the close relationship between the fortified settlement and the shoreline.

addressed a gap in the distribution of existing defensive strongpoints. Its usefulness was recognised in relation to a wider community comprising peasants, citizens and subjects of the Republic, whose welfare depended on the security of the territory and their ability to continue cultivating the land.

The grant is particularly significant for the relationship it established between private initiative and public authority. Rotondo undertook to finance construction directly, according to the formula *de aere suo*, while the Venetian government recognised its legitimacy and collective benefit. Use of the coastal area within one hundred paces of the tower was also reserved for the founder, preventing others from building there without permission. At the same time, citizens and peasants of the district were allowed to move into the future settlement, subject to Rotondo's consent. The resulting arrangement placed the construction and control of the complex in the hands of the landowner, while Venetian authority defined and recognised its territorial function. This arrangement was not an isolated occurrence but belonged to a tradition of grants that had gradually become established in the territory of Trogir. An important precedent was the privilege of 1476 concerning the construction of Castel Cippico Vecchio (Kaštel Stari), promoted by Coriolano Cippico. In that instance, the need to protect the agricultural population of the Campo Grande had initially been expressed by the civic community and the nobility of Trogir, who had requested the construction of a fortification near San Pietro. The lack of the necessary public funding subsequently encouraged the intervention of a private landowner willing to erect a fortified building on his own land to provide refuge for the population.

The document of 1476 nevertheless distinguished two functional components: the *palatium sive fortilicium*, identifiable as the fortified place intended for defence, and the *villa*, intended to accommodate the peasants. Permanent settlement was therefore envisaged from the outset, but the terminology maintained a distinction between the space of everyday habitation and that of refuge. The relationship between these components



Fig. 2: Seget in the Austrian cadastre of 1830. Detail showing the fortified settlement, its plots, internal routes and waterfront. The map provides a reference for examining the relationship between the residential fabric and the defensive structures.

did not necessarily preclude their physical proximity, but reflected a conception in which residential and defensive organisation were still recognised as relatively autonomous functions.

A different configuration emerges from the privilege granted to Paolo Antonio Cippico in 1512 for the construction of Castel Cippico Nuovo (Kaštel Novi). This document contains terms that recur almost verbatim in the subsequent grant for Seget: the *turrionum in mari*, the masonry *revelinum*, the drawbridge and the *castrum* intended to accommodate the population. The correspondence concerns both the proposed architectural elements and the structure of the grant and the reasons advanced to justify the intervention. In both cases, private investment was recognised as useful for protecting the owners and their property, but above all for strengthening the territory and ensuring the security of its inhabitants.

The progressive repetition of these formulations reveals a process of standardisation affecting both administrative procedures and the principles governing settlement organisation. The reference to earlier examples, explicitly invoked in the privilege of 1564, demonstrates the existence of an established practice through which Venetian authority permitted the construction of new fortified complexes according to recognisable legal and functional arrangements. It remains to be established, however, to what extent this documentary standardisation also corresponded to the spread of similar architectural models, particularly in the positioning of towers, the configuration of curtain walls and the organisation of residential spaces.

The terminological distinctions in the Seget privilege clearly convey the complexity of this model. The term *turrionum*, or *turrio*, denoted a fortified structure standing in the sea, intended to protect its owner and probably also used as a residence. The term *revelinum* referred instead to a walled space connected to the tower, apparently intended to accommodate and protect the population. In this context, the word cannot automatically be equated with the ravelin of early modern bastioned fortification, since its meaning relates to the configuration of an enclosed, inhabitable space. Finally, *castrum* identified the complex as a whole, recognising the functional unity of its defensive structures and residential organisation.

The use of *castrum* as an overarching category is particularly important because permanent settlement was not an incidental consequence of military construction but an envisaged component of the scheme. Peasants authorised to settle there would benefit from the protection of the walls while continuing to cultivate the surrounding land. The new complex thus became an instrument of territorial organisation, in which defence contributed directly to the formation and consolidation of a settlement.

The speed of this process is attested by demographic evidence from 1578, when Seget already had 122 inhabitants, just fourteen years after the privilege was granted. This figure shows that Rotondo's initiative led



Fig. 3: Jean-Baptiste d'Anville, manuscript map of the Dalmatian coast, eighteenth century. Detail of the Trogir area, showing Seghetto, the island of Bua (Čiovo) and the principal coastal inlets. Source: Bibliothèque nationale de France, Gallica, btv1b5964134p.

to the establishment of a permanent community within a relatively short period, confirming the effectiveness of the settlement model adopted. The fortified complex thus extended beyond the sphere of individual property to become the spatial focus of a population whose activities were tied to agriculture and the territory's economic structure.

The foundation of Seget can be regarded as one of the latest manifestations of the process of coastal fortification that developed between Split and Marina. Chronologically, the complex concludes a sequence of initiatives in which defensive requirements and residential organisation became progressively more closely connected. The construction of isolated fortified buildings, intended primarily as refuges, gave way to settlements in which the walls defined both the boundary and the organising principle of inhabited space.

The history of Seget therefore offers a significant example of how local initiatives, landed interests and Venetian government contributed to the transformation of the Dalmatian landscape. The settlement was the outcome of a process in which the need to protect the rural population led to the definition of new spatial models, which would permanently alter the relationship between the coast, cultivated fields and inhabited centres.

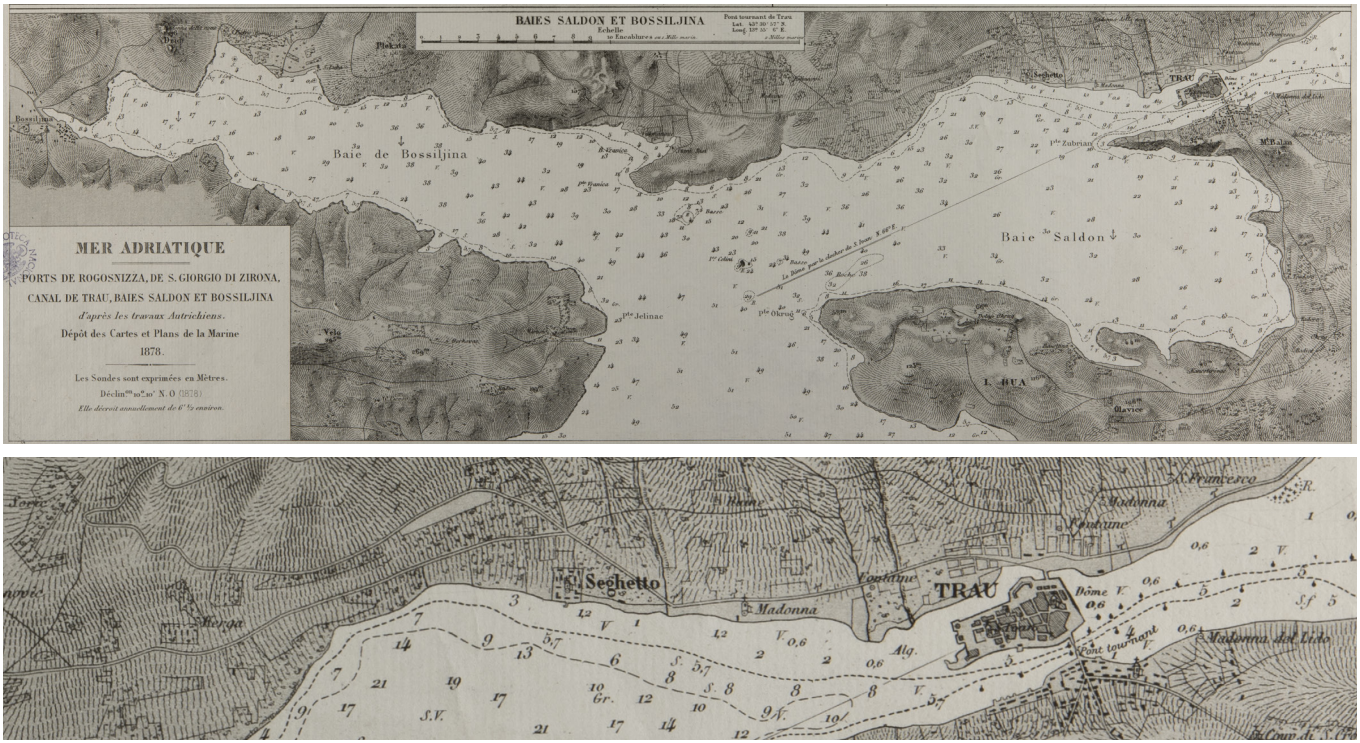


Fig. 4: Dépôt des Cartes et Plans de la Marine, Mer Adriatique. Ports de Rogosnizza, de S. Giorgio di Zirona, Canal de Trau, Baies Saldon et Bossiljina, 1878, chart no. 3627, engraved by J. Geisendörfer. Above: detail showing the bays of Saldon and Bossiljina and the Trogir area. Below: enlarged detail showing Seghetto (Seget Donji), Trau (Trogir) and the intervening coastline. Source: Biblioteca Nacional de España, R. 13792.

Architectural Analysis

The architectural layout of Seget Donji retains several fundamental characteristics of the fortified settlement system that developed along the Dalmatian coast during the sixteenth century. Alongside these recurring features, the settlement nevertheless displays certain distinctive qualities, apparent in the relationship between the geometric regularity of the fortified perimeter, the organisation of the residential fabric and its original relationship with the sea. These features provide a basis for comparison with the other *kaštela* in the territory of Trogir.

The historic nucleus has an almost rectangular plan, elongated along a north–south axis, with overall dimensions of approximately 83 metres along its longer side and 60 metres along its shorter side, excluding the projections of the corner towers. The layout shows a predominantly inland development, in a direction approximately perpendicular to the shoreline. This configuration distinguishes it from Castel Cippico Nuovo, whose plan develops mainly parallel to the coast.

The difference between the two settlements is particularly significant when considered in relation to the similarities between their respective foundation privileges. The documentary formulations of 1512 and 1564 envisaged comparable structures, comprising a fortified tower, a walled space and a connection to the

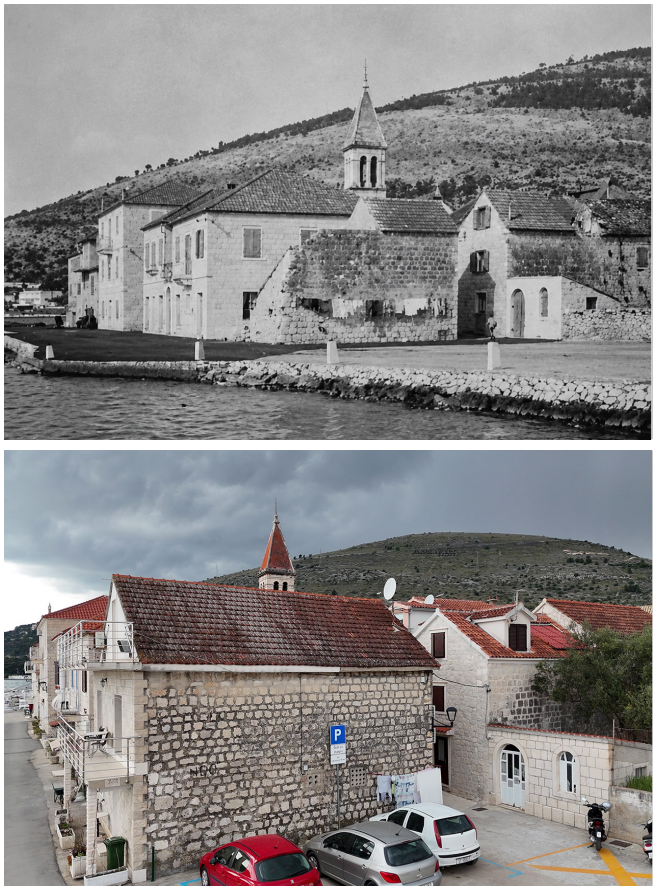


Fig. 5: Seget Donji. Early twentieth-century photograph (above; source: Trogir Time Travel) and present-day view (below) of the waterfront beside the parish church, documenting changes to the coastal edge and the relationship between the church, adjacent buildings and public space.

mainland. Their different plans nevertheless indicate that the repetition of functional principles did not necessarily entail the reproduction of a uniform geometric scheme. The arrangement of the structures could vary according to the site's morphology, coastal conditions and the organisation of the surrounding land, while retaining a recognisable consistency in the relationship between defence and residence.

An initial interpretative question concerns the correspondence between the dimensions of the present settlement and those specified in the privilege of 1564. The document envisaged a square *revelinum* measuring twenty-four paces on each side, equivalent to just over 41 metres if the Venetian pace is taken as approximately 1.73 metres. The configuration recognisable today has different proportions and is considerably larger, particularly along the north–south axis. This discrepancy suggests that the authorised scheme may have been modified during construction, or that the dimensions specified in the privilege referred to a particular component subsequently incorporated into a larger complex.

The lack of a direct correspondence between the documentary measurements and those of the present nucleus is therefore significant for reconstructing the settlement's formative phases. A distinction must be drawn between the configuration envisaged in the foundation document, the actual construction of the defensive structures and the subsequent transformation of the settlement. The present layout reflects the outcome of this process, retaining features attributable to the sixteenth-century scheme alongside alterations arising from changing residential requirements.

The fortified system comprised stone curtain walls reinforced by four quadrangular towers at the corners. The towers projected slightly beyond the alignment of the walls, allowing flanking control of the perimeter and protection of the areas immediately outside the enclosure. Their positioning concentrated defensive capabilities at strategically significant points, while the curtain walls primarily served to enclose and protect the settlement. The corner structures have battered bases and openings associated with the use of firearms, including loopholes and gunports of different sizes. These features demonstrate the adaptation of the defences to early modern modes of warfare, although the configuration of the complex remained distinct from the bastioned systems built in the Republic's principal fortified centres. At Seget, protection relied primarily on



Fig. 6: Seget Donji. Aerial view of the historic nucleus, showing the compact residential fabric, the parish church and the settlement's present relationship with the waterfront and the surrounding urban development.

the enclosure of the perimeter and the towers' ability to control the entrances and adjacent stretches of wall.

Of particular interest is the north-western tower, which preserves traces of stone corbels attributable to a defensive structure above the entrance. These elements help clarify the role of the towers within the settlement's defensive system, showing how their configuration responded to requirements for close-range control and defence at specific points. Analysis of the surviving architectural devices, compared with the characteristics of the other towers, may provide further evidence of differences in construction and function within the perimeter.

The curtain walls appear to have been relatively thin, described in the available material as approximately 60 centimetres thick, with an estimated original height of around four metres. Their limited thickness suggests a primarily protective function, consistent with a system in which active defence was concentrated in the towers. The presence of a continuous crowning structure and a possible wall-walk along the curtains also remains an open question. There is insufficient evidence to reconstruct their original upper configuration with confidence, since it has been substantially affected by subsequent alterations.

The possible absence of continuous defensive circulation along the walls would have important implications for interpreting the relationship between the fortified enclosure and the residential fabric. If the curtains primarily provided passive protection, houses could have been built close to their inner face, using the wall itself as an organising boundary. Possible parallels can be found at Castel Cippico Nuovo, where residential



Fig. 7: Seget Donji. Two surviving corner towers within the present residential fabric. Their masonry, battered bases and altered openings preserve evidence of the relationship between the defensive perimeter and subsequent residential adaptations.

buildings have been proposed as adjoining the walls from the settlement's earliest phases.

At Seget, the close integration of houses and defensive perimeter is clearly recognisable in the present configuration, although it remains difficult to establish when it originated. Subsequent transformations introduced openings, altered the relationships between structures and progressively adapted the walls to the requirements of everyday life. Interpretation of the complex must therefore allow for the possibility that some relationships between buildings and fortifications belong to the original configuration, while others result from later alterations and amalgamations.

A central aspect of the defensive system concerns its relationship with the shoreline. The present configuration of the southern edge does not fully reflect the geographical conditions at the time of foundation. Changes to the coast and subsequent works along the waterfront have altered the relationship between the fortifications and the sea. A depiction of 1763 records a situation in which the water directly adjoined the southern boundary of the settlement, highlighting the coast's active role in its protection.

The proximity of the sea is particularly significant for the configuration of the curtain walls. In the eighteenth-century depiction, the northern, eastern and western stretches of the perimeter are clearly identifiable, whereas the southern edge does not show a continuous wall between the corner towers with the same clarity. This makes it possible to hypothesise that the settlement was originally protected by three fortified sides facing inland,



Fig. 8: Seget Donji. A waterfront corner tower, showing its integration into the residential fabric and alterations to its openings and roof.

while the defence of its southern frontage relied at least partly on the water.

Such a solution would be consistent with the defensive principles adopted in coastal settlements around Trogir, where the sea, channels and natural configuration of the sites could reinforce the protection of inhabited areas. At Seget, however, the absence of a southern curtain cannot be regarded as conclusively established. Changes to the shoreline, the possible disappearance of structures and the characteristics of the historical depictions require a cautious interpretation.

The access system is another determining element in the architectural organisation of the complex. Opposing entrances on the eastern and western sides are connected to the principal route through the historic nucleus, running approximately east–west. Their position linked the settlement to routes in the surrounding territory, regulating the movement of inhabitants and access to the protected spaces.

The principal route runs parallel to the shoreline but does not coincide with the geometric centre line of the fortified rectangle, being shifted slightly southwards. It is associated with a longitudinal north–south route, from which secondary passages branch off to serve the residential units. This forms a relatively simple circulation structure, organised around a few principal axes and a limited number of transverse connections.

Some reconstructions also include an entrance on the northern side, in addition to those on the eastern and western sides.

The street network displays an underlying regularity without producing a strictly geometric subdivision of space. The principal routes establish a recognisable order, but the arrangement of buildings, variations in route widths and the pattern of property boundaries reveal adaptations and irregularities. The settlement's form therefore appears to result from the interaction between a unified fortified perimeter and the progressive occupation of its interior.

In this sense, the settlement's subdivision cannot unreservedly be described in terms of regular urban blocks. It is more appropriate to identify rows of buildings comprising relatively narrow, deep residential units adjoining one another along the principal circulation routes. These residential sequences form a compact fabric in which occupation of the ground appears directed towards the efficient use of space within the protection of the walls. The density and configuration of the residential units reflect the complex's original function as a place in which to concentrate the agricultural population. Its internal organisation does not appear to have envisaged large palatial complexes or prestigious residences distributed throughout the enclosure, but rather a succession of modestly sized houses in close proximity. The predominance of residential use is consistent with the aims expressed in

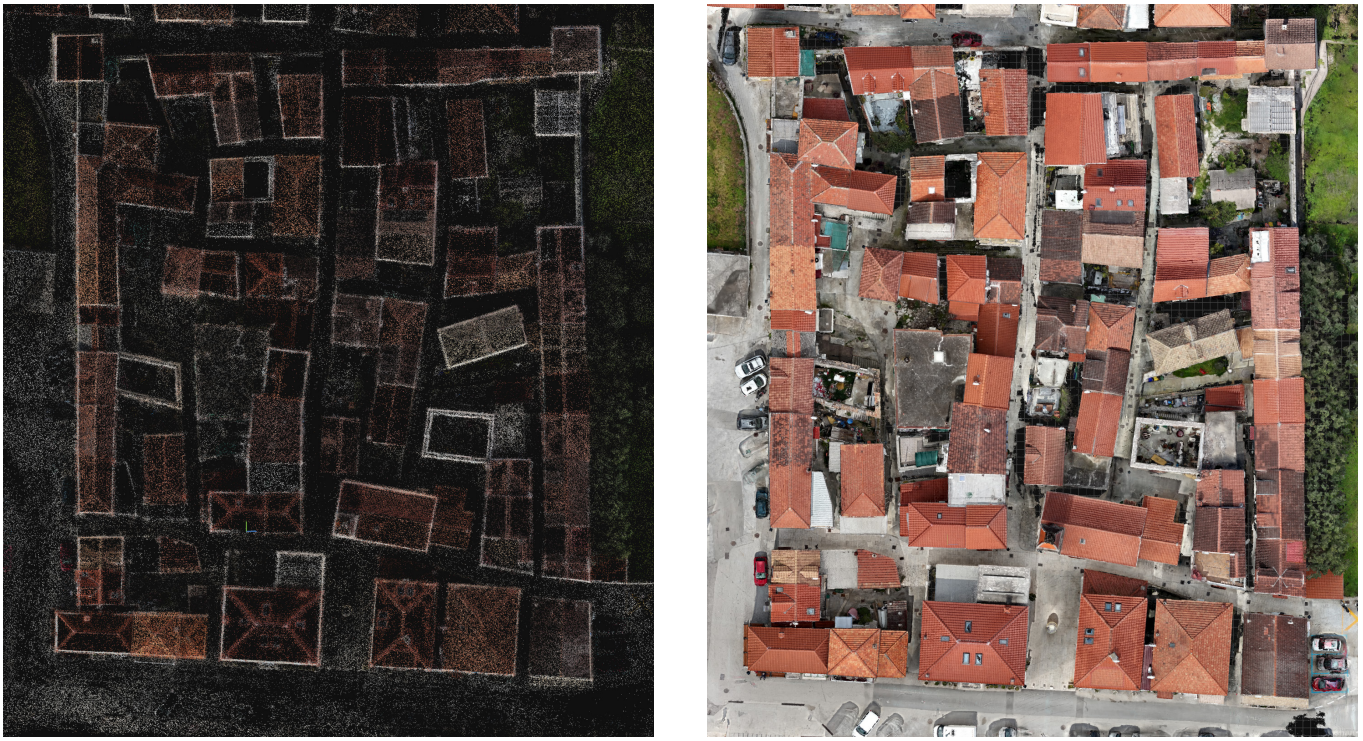


Fig. 9: Seget Donji. Plan views of the sparse (left) and dense (right) point clouds generated through aerial photogrammetry, showing the arrangement of buildings, internal routes and the settlement perimeter.

the privilege of 1564, in which the settlement of peasants was an essential component of the new *castrum*.

Nineteenth-century cadastral documentation provides further evidence for examining this organisation. The Austrian cadastre, dating to around 1830, records a subdivision characterised by repeated, relatively narrow and elongated plots. This configuration may preserve traces of an earlier organising principle, potentially attributable to the settlement's formative phase.

The question of a residential module can be explored further through comparison with Castel Cippico Nuovo. Katja Marasović's studies proposed a reconstruction of the settlement's original houses with dimensions of approximately 5 × 6 metres. At Seget, the repetition of relatively uniform frontages and depths suggests that similar principles of spatial organisation might be identified, although their actual extent must be established through systematic metric analysis.

The identification of a recurring module would enable further examination of the relationship between the dimensions of the residential units, the organisation of routes and the overall configuration of the perimeter. Such an investigation could also help establish whether the standardisation observed in the foundation privileges was accompanied by shared dimensional principles, subsequently adapted to different topographical conditions.

Particular attention should be paid to the relationship between residential units along the perimeter and those in the settlement's interior. In some areas, the former appear smaller than the central properties, suggesting possible differences in the ways the ground

was occupied. Examining these relationships could help distinguish phases of development and establish whether the distribution of buildings was defined through an initial plan or gradually assumed its present configuration.

A further issue concerns communal spaces. The present settlement has a focal point near the church, located within the fortified perimeter and connected to the principal routes. This configuration nevertheless results from a transformation subsequent to the sixteenth-century foundation. The religious building appears to have been introduced within the settlement only in the eighteenth century, while the earlier parish church stood outside the fortified nucleus.

The church's present location cannot therefore be used as evidence of an originally planned central square. The arrangement of routes and the subsequent introduction of religious and communal functions instead demonstrate the settlement's gradual consolidation and the transformation of a space initially organised around defensive and residential requirements into a complex with additional communal functions.

Identifying Giacomo Rotondo's original residence is another particularly significant interpretative question. The privilege of 1564 expressly envisaged a tower standing in the sea and connected to the mainland by a drawbridge. This configuration recalls other fortified complexes in the Kaštela area, where the seigneurial tower formed a distinct architectural element directly related to the coast and the space intended to accommodate the population.

In Seget's present configuration, however, no structure can be securely identified as corresponding to the description in the grant. The tower may have been altered, incorporated into later buildings or lost following changes to the waterfront. The possibility that one of the corner towers served a residential function must also be considered cautiously, distinguishing surviving architectural features from information derived from historical sources.

A particularly interesting indication is provided by the



Fig. 10: Seget Donji. Two false-colour views of the survey point cloud, showing a surviving tower and its connections with adjacent walls and buildings.

Austrian cadastre of 1830, which depicts the south-eastern tower as a freestanding volume, separate from the walled perimeter and projecting towards the sea. Its position lies noticeably beyond the southern line of the curtain walls and appears to suggest a relationship with an earlier coastal configuration, preceding subsequent changes to the shoreline. The structure, marked as a ruin in the nineteenth-century documentation and no longer standing, may correspond to the tower envisaged for Rotondo.

The hypothesis is consistent with the building's position near the waterfront and facing towards Trogir, but remains unconfirmed. The cadastral depiction records neither the drawbridge envisaged in the privilege nor evidence sufficient to establish the structure's original

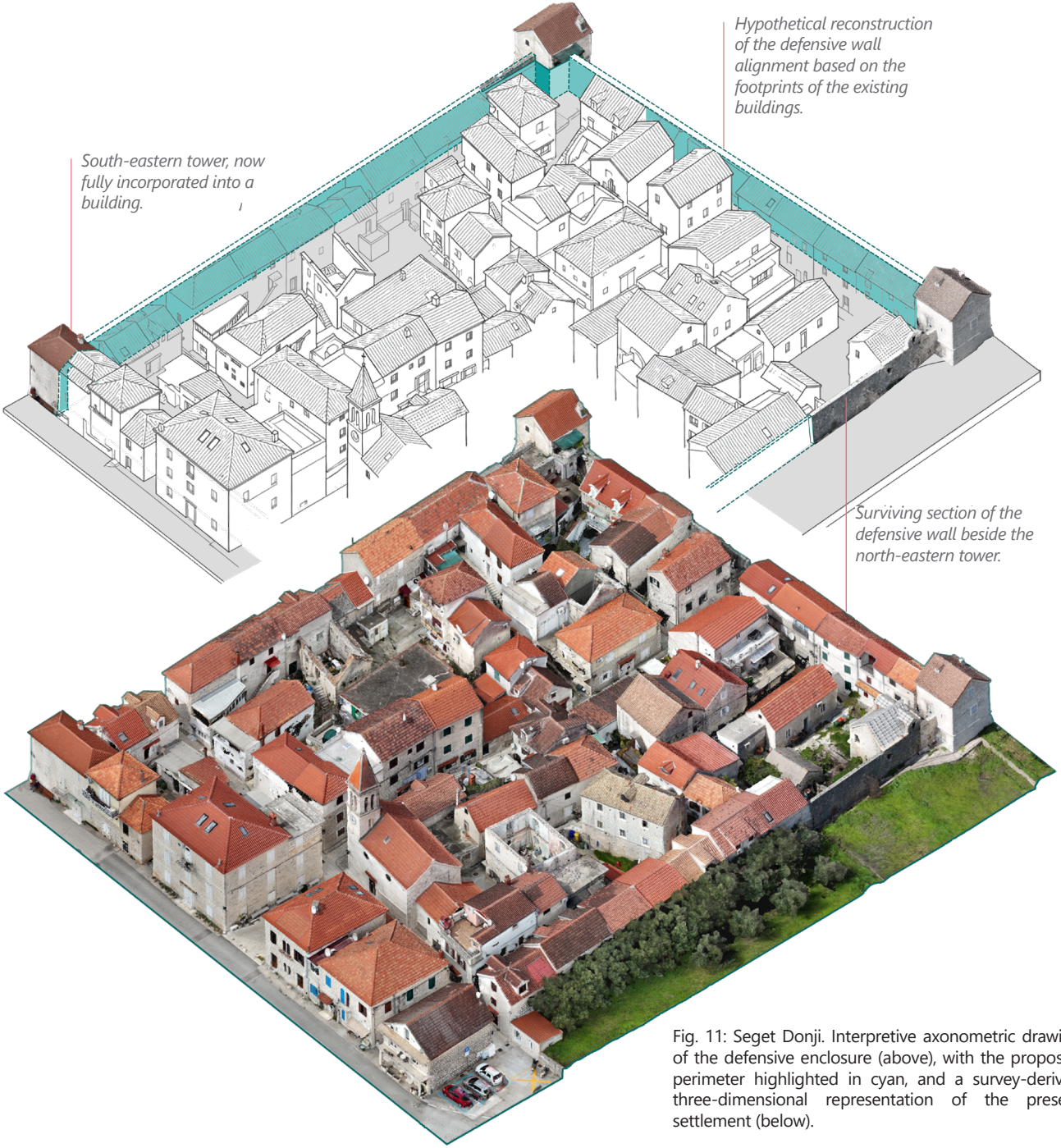


Fig. 11: Seget Donji. Interpretive axonometric drawing of the defensive enclosure (above), with the proposed perimeter highlighted in cyan, and a survey-derived three-dimensional representation of the present settlement (below).

function. Its possible identification with the founder's residence is therefore an interpretation requiring further investigation through comparison of historical cartography, archaeological evidence and surviving architectural features.

The relationship between the seigneurial tower and the communal residential space has implications beyond the identification of a lost building. A possible position along the southern edge would help clarify the hierarchical organisation of the complex, distinguishing the founder's residence from the spaces intended for the population. In this sense, the relationship between *turrionum*, *revelinum* and *castrum*, already recognisable in the terminology of the privilege, finds a possible architectural expression in the combination of specialised defensive elements, controlled routes and residential units concentrated within the enclosure.

The overall analysis of Seget therefore reveals a settlement in which the regularity of the fortified perimeter is combined with a more complex internal arrangement of buildings. The geometry of the enclosure, the distribution of corner towers, the controlled entrances and the relationship with the sea reveal a system conceived to provide security for the population. At the same time, the circulation structure, the sequence of residential units and the progressive integration of houses with the defensive walls demonstrate the complex's adaptation to the needs of a permanent community. Comparison with the other *kaštela* of central Dalmatia allows Seget to be interpreted as a variant of a shared architectural and settlement model rather than the reproduction of a predetermined plan. Standardisation appears to concern primarily the relationship between the system's fundamental elements: the defensive enclosure, towers, entrances, relationship with water and concentration of housing. Geometric and distributive solutions instead respond to the specific conditions of each site, introducing variations that reveal the complexity of the processes through which these settlements were founded and developed.

Digital Documentation and Research Perspectives

The digital documentation of Seget Donji addresses the need to establish a shared reference for studying a settlement in which defensive structures and residential fabric are closely intertwined. The outcome achieved to date is a metrically reliable three-dimensional database produced through the integration of laser scanning and photogrammetric acquisitions. Its scientific value lies in the possibility of revisiting the built fabric through new questions, comparing observations and interpretations within a common spatial reference. In this perspective, the survey represents an investment in knowledge whose usefulness can extend beyond the activities and duration of the project that produced it.

Morphometric accuracy provides a basis for analysis, while identifying components, functions and transformations requires interpretative work informed by different disciplines and sources[1]. This is particularly significant at Seget, where a single material configuration may preserve traces of different uses and phases of transformation, and where visual continuity may conceal construction discontinuities. The database makes it possible to locate and correlate these observations, retaining a verifiable relationship between documented characteristics and proposed interpretations.

An initial contribution therefore concerns the possibility of making the construction of historical hypotheses explicit. The question of the southern frontage, for example, could be addressed by linking the surveyed portions to evidence from the drawing of 1763, surviving wall traces and subsequent changes to the shoreline. An information environment developed from the database

[1] S. Parrinello and A. Pettineo, "Databases and Information Models for Semantic and Evolutionary Analysis in Fortified Cultural Heritage", *Heritage* 8, no. 1 (2025): article 29, https://doi.org/10.3390/heritage8010029; A. Pettineo, "La seduzione del dato digitale: orientarsi nel patrimonio fortificato tra Italia e Croazia", in *Il disegno furioso. Atti del 47° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione*, edited by M. Balzani, M. Incerti, F. Maietti, L. Rossato and F. Raco (Rome: UID Press, 2026), 2401–20.

could distinguish what is observable today, what is attested by the sources and the additions required for a reconstruction. This would enable alternative interpretations of the same element to be compared and revised as new evidence emerges. Three-dimensional representation would thus support scholarly discussion, making the limits of reconstructions visible as well.

The relationship between language and form constitutes a second area for development. Linking terminologies and information models offers ways of addressing uncertain relationships and meanings that are not fully equivalent across historical and linguistic contexts[2].

The database may also contribute to a comparative reading of fortified coastal settlements. At Seget, the recurrence of the grant formula raises the question of how widely the relationships between the founder's residence, enclosure, houses and entrances were shared. Comparable documentation of different settlements would make it possible to examine their orientation towards the coast, the arrangement of routes, the relationship between houses and walls, and the use of water in defence. Comparison would help establish which characteristics recur and which depend on local conditions. The territorial dimension of the research would thus emerge from the relationships between the cases, contributing to an understanding of how a shared political and legal framework could produce different settlement configurations.

A further perspective concerns the temporal dimension of documentation. The database records a configuration of the built fabric against which subsequent observations can be assessed. New campaigns, if conducted using compatible criteria and appropriate checks, could support the study of building alterations, interventions or changes to surfaces. In parallel, archival documents, photographs, stratigraphic interpretations and conservation information could be added over time. The information resource could therefore grow without repeating the entire survey, through disciplinary contributions that extend its content and revise its interpretations.

One planned development is the inclusion of Seget in a digital platform currently under development, conceived as a navigable virtual environment connecting the cases examined in the present project with those documented during earlier and parallel research initiatives. The database could support representations of the present state and reconstructions of historical configurations, linked to the sources and hypotheses on which they are based. Navigation would allow users to move from examining an individual settlement to comparing it with other contexts through geographical, chronological and thematic pathways.

Within this environment, historical reconstruction could become a means of accessing the interpretative process: exploring a past configuration would allow users to identify the evidence employed, the conjectural parts and subsequent transformations. Connecting cases studied in different projects would also bring together a progressively accumulated body of documentation and make it available for new comparative readings. The platform would thus offer a concrete prospect for continuity in research, enabling the outcomes of individual campaigns to be updated and connected within a shared system.

Continuity beyond the project nevertheless requires this potential for reuse to be sustained over time. Preserving acquisitions and their provenance, documenting processing and identifying versions, responsibilities and access conditions enable other researchers to understand the content and assess its suitability for use. The transferability of data and information relationships between different environments becomes part of the documentation's long-term scholarly value.

[2] A. Pettineo and S. Parrinello, "Visualising Relation Between Terminologies and HBIM Models for Historic Architecture", *Heritage* 9, no. 4 (2026): article 140, https://doi.org/10.3390/heritage9040140.

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DEFENCE OF THE SOUTHEASTERN PART OF CONTADO DI ZARA PAKOSTANE, SV. FILIP I JAKOV, TURANJ

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Introduction

It is generally accepted that Ottoman incursions into the territory of the communes of Venetian Dalmatia became frequent after the fall of Bosnia in 1463[1]. However, the first major Ottoman incursion into the territory of the medieval Zadar commune (*Contado di Zara*) from the direction of Bosnia took place as early as the spring of 1432, when Ishakbeg, with some three thousand soldiers, ravaged the Zadar district[2]. Immediately after the fall of Bosnia, Venice took the first steps to strengthen the defence of the Dalmatian towns, and on 12 December 1468 the Venetian Senate decided to send military aid simultaneously to Zadar and Šibenik[3]. Through conquests in the first half of the 16th century, which culminated in the capture of Vrana in 1538, the Ottomans secured bases for direct and frequent attacks on Zadar's territory[4]. After the Cyprus War (1570–1573), the Ottomans' major territorial gains at the expense of the communal territory of Zadar were confirmed, and a border was established that would remain virtually unchanged until the end of the 17th century[5]. The Dalmatian communes and powerful noble families respond to the Ottoman threat, among other things, by building various fortifications to defend their territories. Thus, by the late 15th century and in the first decades of the 16th century, typical communal fortresses, individual towers and watchtowers, nobleman's strongholds and fortified summer residences were being built in the territories of Split, Trogir and Šibenik. As a special type of defensive architecture, the nobles built fortified settlements to protect the population working on their estates and to safeguard any other inhabitants who might find themselves in danger within the commune's territory. All these types of fortifications have been well-researched in the scholarly literature for the territories of the medieval communes of Split, Trogir and Šibenik, whereas the fortifications on the communal territory of Zadar are less well-known[6].

[1] Tomislav Raukar, "Komunalna društva u Dalmaciji u XV st. i u prvoj polovini XVI stoljeća," *Historijski zbornik* 35, no. 1 (1982): 90-93.

[2] Seid Traljić, "Nin pod udarom tursko-mletačkih ratova," *Radovi Instituta JAZU u Zadru* 16-17 (1969): 531.

[3] *Listine o odnošajih izmedju južnoga slavenstva i Mletačke Republike*, vol. X, ed. Šime Ljubić (Zagreb: Jugoslavenska akademija znanosti i umjetnosti, 1891), 418-419.

[4] Seid Traljić, "Zadar i turska pozadina od XV do potkraj XIX stoljeća," *Radovi Instituta JAZU u Zadru* 11-12 (1965): 207; Amos Rube-Filipi, "Biogradsko-vransko primorje u doba mletačko-turskih ratova s osvrtom na povijest naseljenja," *Radovi Instituta JAZU u Zadru* 19 (1972): 407.

[5] Seid Traljić, "Zadar i turska pozadina od XV do potkraj XIX stoljeća," *Radovi Instituta JAZU u Zadru* 11-12 (1965): 212.

[6] Here we will provide only the most important bibliography relating to the fortresses of Split, Trogir and Šibenik: Ivan Alduk, "Tvrđava Kuk

This paper will address the defence of the extreme, very narrow south-eastern part of the former Zadar communal territory (*contado di Zara*), which borders the communal territory of Šibenik. Particular attention will be paid to the construction of the fortified settlements of Pakoštane, Sv. Filip i Jakov and Turanj[7]. Today, these settlements are geographically situated in the Biogradsko Primorje. The primary aim will be to attempt, for the first time, to delineate the boundaries of former historical settlements within modern settlements, which developed organically throughout the 19th and 20th centuries – and particularly in recent times – and have spread beyond the boundaries of the historical settlements. A barrier to uncontrolled contemporary construction, in addition to spatial plans, should also be the conservation protection of all three settlements, which was introduced relatively recently. Most of the settlements' ramparts have disappeared, while parts of the ramparts are concealed within existing buildings that stand along the line of the fortifications. Therefore, the detection of the old fortification structures will be based on recognising the remains of the defensive structures and joining them into a presumed whole. In this regard, the first Austrian cadastral survey of Dalmatia was of great help, which for this part of the former Zadar commune was carried out starting from 1825. This cadastral survey actually depicts the situation from the period of late Venetian rule in Dalmatia, as there was no significant increase in population or settlement growth until the second half of the 19th century.



Fig. 1: The first Austrian cadastral map of Pakoštane (source: Arcanum Maps - https://maps.arcanum.com/en/)

Pakoštane

It is not clear whether Pakoštane had defensive ramparts as early as the late 15th or early 16th century. However, as the Ottomans frequently attacked the area in the early 16th century, most intensely in 1521, the population scattered, mainly to the nearby islands[8]. The situation was the same after the Cyprus War, as in his report to the Venetian Senate upon his return from duty on 27

iznad Kučina," *Tusculum* 2 (2009): 71–83; Duško Kečkemet, "Splitska utvrda Kamen," *Prilozi povijesti umjetnosti u Dalmaciji* 22, no.2 (1980): 120-136; Ivo Babić, *Prostor između Trogira i Splita* (Trogir: Muzej grada Trogira, 1984); Katja Marasović, "*Kaštelanski kašteli*" (PhD diss., Sveučilište u Zagrebu, 2002); Ivo Glavaš, "Kaštel Andreis u Zamurvi (Jadrtovcu) u Morinjskom zaljevu kod Šibenika,"*Godišnjak zaštitte spomenika kulture Hrvatske* 39 (2015): 125–130; Ivo Glavaš and Ivo Šprljan, "Utvrde u šibenskom *campo di sotto* – ostaci kaštela Vrpolje i kule Parisotto," *Portal* 7 (2016): 135-146; Ivo Glavaš, Andrija Nakić, and Josip Pavić, "Rakitnica, Dazlina, Velim – ostatci nekadašnje obrane zapadnog dijela šibenskog distrikta," *Radovi Zavoda za povijesne znanosti HAZU u Zadru* 62 (2020): 113-138.

7 For the meaning of the term *contado*, see: Tea Mayhew, *Dalmatia between Ottoman and Venetian Rule. Contado di Zara 1645-1718* (Rome: Viella, 2008), 146-147.

8 Luka Jelić, "Povjesno-topografske crtice o Biogradskom primorju," *Vjesnik Arheološkog muzeja u Zagrebu* 3, no. 1 (1898): 46; Marino Sanuto, *I diarii,* vol. XXIX (Venice: Fratelli Visentini, 1890), 575, 594.

March 1586, the Zadar count Zuan Battista Michiel writes that Pakoštane was "*villaggio dishabitato*"[9]. In the same report, the count also states that Pakoštane had been granted as an estate to the Zadar noble family Carnaruti. On 10 September 1597 an agreement was concluded between Margarita, widow of Bernard Carnaruti, on the one hand, and Marko Punošević and Miha Radošinović on the other, as representatives of the twelve families who were to settle in Pakoštane. The families undertook to settle in Pakoštane and to build a defensive rampart around the settlement: *Il detto Marco Punossevich e Mio Radavinovich per li sopradetti nomi promettono, et si sono obligati per se, eredi et successori col presente publico instrumento promettono, et obligono popollare villa Vecchia di Pacoschiane guirisdizione di Zara, e fare il Muro intorno tutta la villa sopradetta per sigurtà de villici, et a loro spese fare una buona calcara, e tutta la calcina, che farà in essa spendere nel Muro, col quale si circonderà detta villa, che si deve popolare*[10]. The terms of the contract for the future inhabitants of Pakoštane were quite harsh, but this was not unusual for the time. When the contract for the construction of the fortress at Ražanac, in the very north of the Zadar territory, was drawn up, the terms of the agreement that the Zadar nobles (among whom the Carnaruti were again present) imposed on the new inhabitants were also harsh. Among other requirements, they were required to build ramparts, towers and houses at their own expense if they wished to settle on the Zadar nobles' estate in Ražanac[11]. Interestingly, not all the families who undertook to settle in Pakoštane were from the territory of the Zadar commune. Some families were from Zlosela (present-day Pirovac), and others from Murter, which was part of the territory of the neighbouring Šibenik commune. The contract did not stipulate any conditions for building houses within the walls, nor the relationship between private and public spaces, nor did it explicitly prohibit the construction of buildings on the ramparts. After the construction of the Pakoštan walls, the Ottomans unsuccessfully attempted to capture the settlement, so for preventative reasons, the *Provveditore Generale in Dalmazie e Albania* Leonardo Foscolo ordered in 1646, at the beginning of the Candian War (1645–1669), the walls of Pakostane to be demolished, which was a common practice at the time[12].



Fig. 2: The presumed perimeter of the Pakoštane ramparts (photo: A. Nakić)

Pakoštane is located on the coast at the extreme south-eastern point of the former Zadar territory, about 35

[9] *Commisiones et relationes Venetae*, vol. IV, ed. Grga Novak, (Zagreb: Jugoslavenska akademija znanosti i umjetnosti, 1964), 372.

[10] See the text of the contract in: Amos Rube-Filipi, "Biogradsko-vransko primorje u doba mletačko-turskih ratova s osvrtom na povijest naseljenja," *Radovi Instituta JAZU u Zadru* 19 (1972): 495-496.

[11] Emil Hilje, "Gradnja kaštela u Ražancu 1507. godine," *Radovi Zavoda za povijesne znanosti HAZU u Zadru* 50 (2008): 119–145.

[12] Franjo Difnik, *Povijest Kandijskog rata u Dalmaciji* (Split: Književni krug, 1986),76.



Fig. 3: The square tower in Pakoštane (photo: I. Glavaš)

kilometres from Zadar and just one kilometre from the north-western edge of Lake Vrana. Since the narrowest historic core of the settlement is densely built, it is very difficult today to determine the boundaries of the historic settlement within the defensive walls, especially along the coastline where it is almost impossible. This is not helped by the first Austrian cadastral survey, which was carried out for Pakoštane in 1825. Even then, buildings had encroached upon the defensive walls, so their direction cannot be determined with certainty on the cadastral map. The only reliable remnant of Pakostane's former walls is a square, roofed tower located in the west of the settlement. We could say that it marks the western stretch of the former defensive walls. Traditionally, it is believed that the present-day King Tvrtko Street is the northern boundary of the defensive walls, as the main entrance to the settlement once stood somewhere in its middle. In this way, we can to some extent define the western and northern boundaries of the historic walled Pakoštane. The eastern and southern boundaries can only be inferred, as it is impossible without invasive investigations to say whether the remains of the ramparts are located in some of the houses on the edge of King Tomislav Square and King Krešimir's Waterfront. Indeed, the construction of residential buildings along the line of the defensive walls is not the exception but the rule in similar fortified settlements along the Dalmatian coast, which very often makes the identification of the remains of the defensive walls difficult. Residential buildings most often have plastered external walls, so traces of the ramparts cannot be seen without investigation.

It appears that no sacred building originally existed within the defensive ramparts of Pakoštane. The oldest parish church of Pakoštane was most likely the Church of St. Justina on a nearby islet, just two hundred metres from Pakoštane. During his 1671 visit of Pakoštane, the Archbishop of Zadar, Ivan Parzago, wrote that the Church of St Justina had once been the parish church[13]. The church on the islet most likely existed since the Middle Ages, as it appears on the first known map of the Zadar and Šibenik municipal territory, a map by Matteo Pagano from around 1530[14]. The church was later renovated and remodelled several times. On the

[13] Amos Rube-Filipi, "Biogradsko-vransko primorje u doba mletačko-turskih ratova s osvrtom na povijest naseljenja," *Radovi Instituta JAZU u Zadru* 19 (1972): 469.

[14] On the map of Mateo Pagano see: Damir Magaš, "Geografske odrednice nastanka karte Matea Pagana: Cijeli okrug Zadra i Šibenika (Tutto el contado di Zara et Sebenicho), Venecija, oko 1530." in *Triplex Confinium (1500. – 1800.): ekohistorija*, ed. Drago Roksandić, Ivan Mimica, Nataša Štefanec and Vinka Glunčić-Bužančić (Split: Književni krug, Zagreb: Zavod za hrvatsku povijest Filozofskog fakulteta Sveučilišta u Zagrebu, 2003), 13-28.



Fig. 4: Map by Matteo Pagano (source: Magaš, Geografske odrednice, 27)

same Venetian map, no settlement is visible on the site of today's Pakoštane; instead, above the islet with the depiction of St. Justina's church, the name *Pagosciat* is written. This is entirely consistent with the historical record that in the first decades of the 16th century, the population of the coastal, south-eastern part of the former Zadar municipal territory fled to the islands in the face of the Ottoman advance. The construction of houses within the perimeter of Pakoštane's former ramparts is so dense, as can be seen on the very first Austrian cadastral survey, that it is difficult to speak of the arrangement of buildings in relation to public spaces. The dense construction within the walls of Pakoštane is consistent with historical data on the significant increase in population in the 17th century[15]. It should also not be forgotten that the area of Pakoštane within the walls is twice as small as, for example, that of Sv. Filip i Jakov. Therefore, it is perfectly clear that this spatial framework may have been sufficient for only twelve families, who initially settled in Pakoštane at the end of the 16th century.

[15] Amos Rube-Filipi, "Biogradsko-vransko primorje u doba mletačko-turskih ratova s osvrtom na povijest naseljenja," *Radovi Instituta JAZU u Zadru* 19 (1972): 468.



Fig. 5: View of Sv. Filip i Jakov (photo: A. Nakić)

Sv. Filip i Jakov

In the Middle Ages, on the site where the settlement of Sv. Filip i Jakov now stands, the abbey of Rogovo had its own estates, agricultural buildings and a harbour[16]. The settlement was destroyed in 1521 during the same Ottoman attack that also destroyed the other settlements of the present-day Zadar coast[17]. Because it is not mentioned in any known or published historical sources, the general conclusion is that the territory where the settlement of Sv. Filip i Jakovs was located remained deserted for a long time after those events. The attempt to resettle Sv. Filip i Jakov is recorded in the report to the Venetian Senate in 1581 by the Zadar captain Lorenzo Cocco. Cocco asserts that substantial funds would be required to build a fortress for the

[16] For the abbey in Rogovo, see: Luka Jelić, "Povjesno-topografske crtice o Biogradskom primorju," *Vjesnik Arheološkog muzeja u Zagrebu* 3, no. 1 (1898): 57-101.

[17] Amos Rube-Filipi, "Biogradsko-vransko primorje u doba mletačko-turskih ratova s osvrtom na povijest naseljenja," *Radovi Instituta JAZU u Zadru* 19 (1972): 446.

resettlement of Sv. Filip i Jakov[18]. However, the fortified settlement was never built, as the count of Zadar Zuan Battista Michiel wrote in his report to the Senate on 27 March 1586 that the settlement of Sv. Filip i Jakov was "*villagio per la guerra dishabitato*"[19]. The first reliable record of defensive walls being built at Sv. Filip i Jakov dates from 1644, just before the outbreak of the Candian War[20]. The defensive walls were most likely constructed several decades earlier. *Provveditore Generale* Leonardo Foscolo had the relatively new defensive walls of Sv. Filip i Jakov demolished at the outset of the Candian War for preventive reasons, along with those of Pakoštane and Turanj[21].

Sv. Filip i Jakov is located on the coast, just three kilometres north-west of Biograd and 25 kilometres south-east of Zadar. In the centre of the settlement, in its historic location, stands the parish church of St Michael. Remains of the defensive walls and towers are visible in several places. On the map of the settlement's first Austrian cadastral survey from 1826, Sv. Filip i Jakov is shaped like an irregular square. Unlike Pakoštane, in the case of Sv. Filip i Jakov, the disappearance of the majority of the defensive walls' perimeter due to new construction did not occur. For this reason, the historic settlement of Sv. Filip i Jakov is easily legible on maps and aerial photographs. The main entrance to the settlement was located next to the tower at the top of what is now Kuntrata Street, which overlooks the village square. The tower has a ground floor and two storeys, but it was converted into a residential building after the threat from the Ottomans had ceased. There are two coats of arms on the tower. One is the coat of arms of the abbot of the Benedictine monastery in Rogovo, Dominicus Grimani, from 1496[22], and the other is the



Fig. 6: First Austrian cadastral map of Sv. Filip i Jakov (source: Arcanum Maps - https://maps.arcanum.com/en/)

coat of arms of the Markić-Pazinović family, whose members were citizens of Zadar enrolled in the nobility in Nin[23]. Both coats of arms have the shape known as *testa di cavallo*, which appears in Dalmatian heraldry at the end of the 15th and the beginning of the 16th centuries. It is difficult to determine whether the coats

[18] *Commisiones et relationes Venetae*, vol. IV, ed. Grga Novak, (Zagreb: Jugoslavenska akademija znanosti i umjetnosti, 1964), 291.

[19] *Commisiones et relationes Venetae*, vol. IV, ed. Grga Novak, (Zagreb: Jugoslavenska akademija znanosti i umjetnosti, 1964), 372.

[20] Luka Jelić,"Povjesno-topografske crtice o Biogradskom primorju," *Vjesnik Arheološkog muzeja u Zagrebu* 3, no. 1 (1898): 49; Amos Rube-Filipi, "Biogradsko-vransko primorje u doba mletačko-turskih ratova s osvrtom na povijest naseljenja," *Radovi Instituta JAZU u Zadru* 19 (1972): 447.

[21] Franjo Difnik, *Povijest Kandijskog rata u Dalmaciji* (Split: Književni krug, 1986),76.

[22] Luka Jelić, "Povjesno-topografske crtice o Biogradskom primorju," *Vjesnik Arheološkog muzeja u Zagrebu* 3, no. 1 (1898): 68.

[23] Friedrich Heyer Rosenfeld, *Der Adel des Königreichs Dalmatien* (Nürnberg: Bauer und Raspe, 1873), 69.



Fig. 7: The tower at the entrance to Sv. Filip i Jakov (photo: I. Glavaš)

of arms on the tower are *in situ*. If they are, this would mean that as early as the end of the 15th century in Sv. Filip i Jakov a tower, and perhaps defensive ramparts, existed. To date, their existence is not confirmed by known historical sources. In the external walls of the houses built in a row along the Iza sela Street , up to the aforementioned tower, there are remains of the settlement's defensive rampart, preserved *in situ*. This refers to the north-eastern and north-western sections of the defensive walls. From the site of the former main entrance to the settlement, towards the south-east, in the houses built along Kriva Kala Street for a length of about 30 metres, there are remains of the defensive wall. These remains can be traced further in houses that intersect the aforementioned structures at right angles, but not for long, as new construction has disrupted the settlement's original perimeter. Unlike in Pakoštane, it appears that, even along the coastline, the former course of the defensive ramparts of Sv. Filip i Jakov can still be traced to some extent in the existing buildings. The layout of the buildings within the former defensive ramparts has been fairly well preserved, so that even today it can be compared with the first Austrian cadastral survey of 1826.

Turanj

There is no doubt that Turanj already had ramparts and towers by the late Middle Ages, as it is shown enclosed by ramparts on the Venetian map by Matteo Pagano, which can be tentatively dated to 1530. It is owned by the state of Venice, which granted it to various Zadar noble families (Marchi, Venturini)[24]. Turanj is called *Toretta,* or *Torette* in the plural, in historical documents[25]. It appears as *Toreta* on a map by Matteo Pagano. It is assumed that the settlement was destroyed during the aforementioned Ottoman incursion into the Zadar littoral in 1521, but this is not entirely certain. After the Cyprus War, Turanj fell among the settlements that survived thanks to their defensive ramparts. For this reason, the count of Zadar Alvise Dolfin, upon his return from his post in 1578, mentioned Turanj in a report to the Venetian Senate as a rare remaining place in the Zadar territory that was still inhabited[26]. Moreover, in the narrow strip of the south-eastern part of the Zadar communal territory, which is the subject of this study, he mentions only three settlements that survived after the disastrous Cyprus War: Sukošane, Turanj and Biograd. The Ottomans captured Turanj several times

[24] Carlo Federico Bianchi, *Zara cristiana,* vol. 2. (Zara: Tipografia Woditzka, 1879), 159-160.

[25] Carlo Federico Bianchi, *Zara cristiana,* vol. 2. (Zara: Tipografia Woditzka, 1879), 159-160; Amos Rube-Filipi, "Biogradsko-vransko primorje u doba mletačko-turskih ratova s osvrtom na povijest naseljenja," *Radovi Instituta JAZU u Zadru* 19 (1972): 436.

[26] *Commisiones et relationes Venetae*, vol. IV, ed. Grga Novak, (Zagreb: Jugoslavenska akademija znanosti i umjetnosti, 1964), 224.



Fig. 8: Coat of arms of Abbot Dominicus Grimani (photo: A. Nakić)



Fig. 9: Coat of arms of the Markić-Pazinović family (photo: I. Glavaš)

during the Candian War, but the Venetian authorities restored its defensive ramparts each time[27].

The settlement of Turanj is situated on the coast, just six kilometres north-west of Biograd. At the time when Carlo Federico Bianchi published his book entitled Zara cristiana in 1879, three towers were still visible at the corners of Turanj's defensive ramparts[28]. Bianchi was then able to clearly recognise parts of the ramparts, which formed a rectangle. Here is how Bianchi described the defensive ramparts of Turanj from that time:

Questa villa, infatti, cinta di muro, alto quattro piedi, presenta un quadrilatero, da tre torri protetto, la prima delle quali, ancora ben alta nel lato meridionale, la seconda di minor altezza nell'angolo di settentrione, la terza nell' angolo d'oriente, eretta nel 1645[29].

Thus, according to Bianchi, the southern tower was the best preserved. That description probably refers to the tower in the north-east corner of the present settlement, which is the only one that remains. All three towers mentioned by Bianchi are also visible on the first Austrian cadastral map of Turanj from 1826, but they are oriented differently with respect to the cardinal directions. Thus, we see one tower in the western, northern and eastern corners of Turanj, but the remains

[27] Amos Rube-Filipi,"Biogradsko-vransko primorje u doba mletačko-turskih ratova s osvrtom na povijest naseljenja," *Radovi Instituta JAZU u Zadru* 19 (1972): 440-442.

[28] Carlo Federico Bianchi, *Zara cristiana,* vol. 2. (Zara: Tipografia Woditzka, 1879), 160.

[29] Carlo Federico Bianchi, *Zara cristiana,* vol. 2. (Zara: Tipografia Woditzka, 1879), 160.



Fig. 10: View of Turanj (photo: A. Nakić)

of the tower in the southern corner of the settlement are not visible on the Austrian cadastral map, as Bianchi claims. We can conclude that the ramparts of Turanj were evidently well-preserved in the first decades of the 19th century. Due to uncontrolled modern construction, it is unfortunately difficult today to ascertain whether there are remains of the ramparts in the buildings on the south-east and south-west along the shoreline, but it seems that a row of buildings at the far end of the settlement's south-eastern perimeter could be on the original alignment of the ramparts.

The remains of the rampart can be traced in the walls of buildings from the main entrance to the settlement, located approximately midway along the north-western perimeter of the rampart, all the way to the parish church on the north-eastern section of the rampart. The roads surrounding the historic core of Turanj prevent further devastation of the remains of the defensive walls by new construction, but there is a danger of reconstructions of existing buildings along the alignment of the north-eastern part of the walls. The multi-storeyed tower in the northern corner of the rampart, the only one remaining, appears to have had at least two construction phases. The parish church, dedicated to the Blessed Virgin Mary, built after the cessation of the Ottoman threat in the 18th century, intersects the alignment of the settlement's north-eastern rampart. The original church on the same



Fig. 11: The first Austrian cadastral map of Turanj (source: Arcanum Maps - https://maps.arcanum.com/en/)

site was considerably smaller and was located within the boundaries of the defensive rampart of Turanj[30]. According to the first Austrian cadastral survey of Turanj from 1826, the main street leading from the entrance gate in a south-easterly direction, as well as its branch leading to the parish church, remain from the original historical parcel layout within the former boundaries of the settlement. All the remaining spaces were taken up by buildings that were excessively large in both floor area and height.

Conclusion

Ottoman incursions into the territories of Dalmatian communes within Venetian Dalmatia became particularly frequent after the fall of Bosnia in 1463. The Dalmatian communes responded to the Ottoman threat by building fortresses, either by the communes themselves or by powerful noble families to protect the population on their estates. During the 16th century, the Ottomans conquered a large part of the territory of the medieval Zadar commune, and after the Cyprus War (1570–1573), the border between Venetian Zadar and the Ottoman Empire stabilised and remained largely unchanged until the end of the 17th century. The narrowest part of the Zadar territory at that time was on its far south-eastern border in today's Biogradsko Primorje, in the immediate vicinity of the far western border of the Šibenik commune's territory. Settlements in this area were constantly under threat, particularly from attacks from nearby Vrana, which was captured by the Ottomans in 1538. The population frequently fled to the nearby islands, and the settlements changed hands during the wars between the Venetians and the Ottomans in the 16th and 17th centuries. This paper examines three settlements in what is now the Biograd coastal region: Pakoštane, Sv. Filip i Jakov and Turanj. The defensive fortifications of Pakoštane and Sv. Filip i Jakov were built quite late, in the late 16th and early 17th centuries, unlike the fortifications in the communal territories of Split, Trogir and Šibenik, which were mostly built in the late 15th and early 16th centuries. It is only possible to state that the defensive ramparts of Turanj were built at the end of the Middle Ages, as they are shown on a map by Matteo Pagano from around 1530, the first known Venetian map of the Zadar and Šibenik communal territories. The fortified settlements of Sv. Filip i Jakov and Turanj are shaped like an irregular quadrilateral, while the shape of Pakoštane can only be inferred. New construction in Pakoštane had already,

[30] Amos Rube-Filipi, "Biogradsko-vransko primorje u doba mletačko-turskih ratova s osvrtom na povijest naseljenja," *Radovi Instituta JAZU u Zadru* 19 (1972): 438.



Fig. 12: *Left* - Main gate in the ramparts of Turanj (photo: I. Glavaš); *Right* - Multi-storey tower in Turanj (photo: I. Glavaš)

by the time of the first Austrian cadastral survey in 1825, almost completely destroyed the settlement's defensive ramparts. The remains of the ramparts and towers in Sv. Filip i Jakov and Turanj are in various states of preservation, and a large part of the remains are now incorporated into the external walls of houses built along the line of the ramparts, so that without investigation inside the houses, it is not possible to confirm their existence. The ramparts along the coastline at all three settlements appear to have almost completely disappeared, which is logical as the coast has undergone the most changes in modern times. The original layout of buildings and public spaces within the walls has been somewhat preserved only in Sv. Filip i Jakov, whereas in Pakoštani, dense construction with no clear boundaries between buildings is already visible on the first Austrian cadastral survey. This is probably a consequence of the sharp increase in population in the 17th century and the need for space within the confined framework of the fortifications. It remains to be seen whether the conservation measures for all three settlements will, in the foreseeable future, put a stop to the uncontrolled modern development that is threatening the historic structures.

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THE FORTIFIED SETTLEMENT OF VODICE

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Historical Overview

The historiographical debate surrounding the settlement of Vodice is considerable, largely due to its crucial role in providing water to the city of Šibenik,[1] which ultimately led to the settlement's fortification. Researchers have noted that references to Vodice in written records date back to 1402, specifically mentioning the Šibenik communal government's transfer of its entire territory to the Cathedral Church of St. James, while retaining control over water sources and pastures[2]. Vodice, as a distinct settlement, was absent from the mid-15th-century register of parishes and settlements within the Diocese of Šibenik. At that time, nobles, citizens, and craftsmen developed vineyards, olive groves, and residential-economic buildings on plots of land leased hereditarily from the Church of Šibenik[3]. A significant change was initiated in 1455 when the Count of Šibenik issued a decree stating that all inhabitants of Vodice and Tribunj would be collectively responsible for any harm inflicted on the land of a nearby village. Essentially, the existing rules of the Šibenik Statute that applied to rural communities (*ville*) within the Šibenik district were broadened to include Vodice[4].

The Ottoman conquests in the Dalmatian hinterland led to the dispersion of populations along the Dalmatian

[1] During periods of summer drought, the city of Šibenik frequently experienced water shortages. Compare Karla Papeš, "Vodoopskrba u Šibeniku u ranome novom vijeku i popis šibenskih cisterni iz 1808. godine" [Water Supply in Šibenik in the Early Modern Period and the Inventory of Šibenik's Cisterns from 1808], *Vjesnik dalmatinskih arhiva: Izvori i prilozi za povijest Dalmacije* 6, no. 1 (2025): 362–96. One of the earliest documented manifestations of Vodice's economic importance to Šibenik is observed in the account book of St Francis Monastery dating to 1444. The records indicate payment for the transportation of water from Vodice to the monastery's cistern. Following the construction of Šibenik's Four Wells cistern in 1446, the situation improved significantly as it became more cost-effective to obtain water from Vodice. Tončika Cukrov, "Vodice – nastanak naselja, kaštel, početak modernizacije" [Vodice: The Origins of the Settlement, the Castle, and the Beginning of Modernization], in *Vodice kroz povijest: Zbornik radova sa Znanstvenoga skupa Vodice kroz povijest*, ed. Mario Jareb (Vodice–Zagreb: Pučko otvoreno učilište Vodice and Hrvatski institut za povijest, 2022), 210–11. For further discussion, see Joško Ćuzela and Ivo Šprljan, "Četiri bunara u renesansnom Šibeniku" [The Four Wells in Renaissance Šibenik], *Prilozi povijesti umjetnosti u Dalmaciji* 41 (2008): 109–29; and Ivo Glavaš, "Čorićev toranj u Vodicama – šibenska komunalna utvrda" [The Čorić Tower in Vodice: A Communal Fortification of Šibenik], *Godišnjak zaštite spomenika kulture Hrvatske* 40 (2016): 81–90.

[2] Kristijan Juran, "Rodovi, obitelji i prezimena u Vodicama od 15. do 17. stoljeća" [Lineages, Families, and Surnames in Vodice from the Fifteenth to the Seventeenth Century], in *Vodice kroz povijest: Zbornik radova sa Znanstvenoga skupa Vodice kroz povijest* (Vodice–Zagreb: Pučko otvoreno učilište Vodice and Hrvatski institut za povijest, 2022), 84. Cukrov, "Vodice – nastanak naselja," 213–14.

[3] Juran, "Rodovi, obitelji i prezimena," 84.

[4] Moreover, in 1484 Vodice became a chaplaincy, with the chaplain chosen by the Chapter of Šibenik. Compare Juran, "Rodovi, obitelji i prezimena," 86–87.

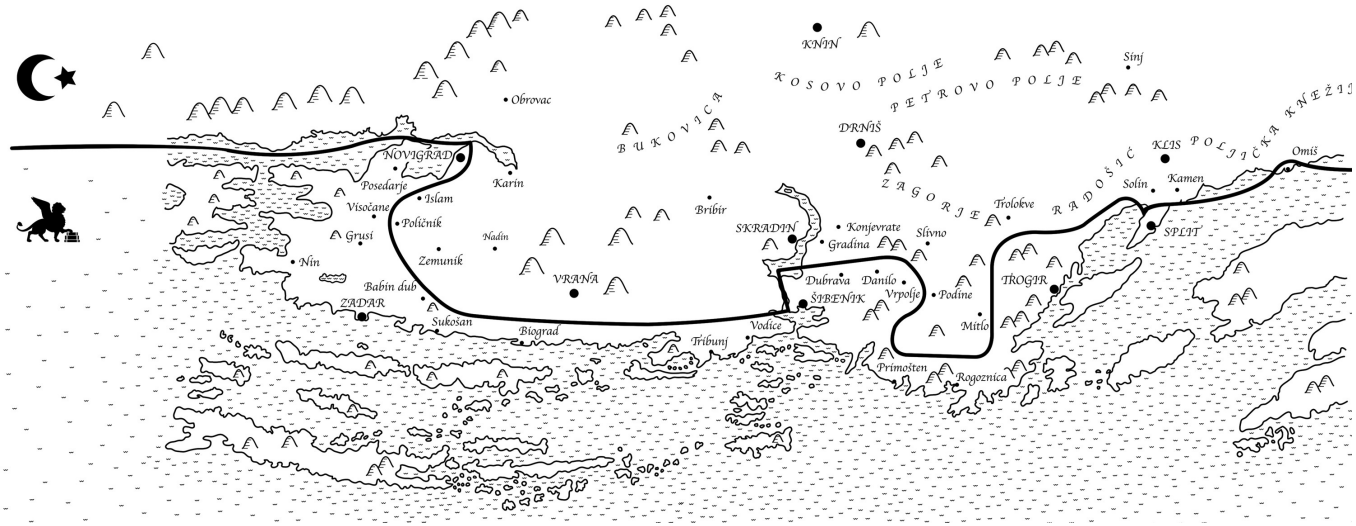


Fig. 1. Venetian-Ottoman border after the War of Cyprus in 1570-73

coast, particularly between 1499 and 1573. Driven by the period of warfare and migrations, both landowners and the Šibenik commune found it necessary to safeguard the foreign tenant farmers dispersed across their properties, alongside the vital water sources essential for Šibenik's water supply[5]. The defence of the Vodice area relied on two strongholds – inland Rakitnica fortress, which fell to the Ottomans in 1571,[6] and Čorić Tower, situated right inside the settlement – thus, when Rakitnica fell, Vodice was severely compromised, leaving it to rely solely on the central tower for protection[7].

The construction of the Čorić Tower, seemingly the first fortification in Vodice, began in the 1530s. Published records highlight the involvement of the Saracenis family in local land transactions, notably Jeronim de Saracenis[8]. Land division documents from 1522 among three brothers reveal that Jeronim obtained the southeastern half of the estate (*dvor*) containing a large house (with his brother Frane receiving the other half), half of the garden, and the southeastern half of the vineyard[9]. By 1532, Jeronim sold one vineyard, and in 1533 he contracted a stonemason named Ivan from Hvar to deliver a specified quantity of xxx stone to Vodice within twenty days, likely marking the initial

[5] Ibid, 86-87.

[6] For further discussion of Rakitnica, see Josip Pavić, Ivo Glavaš, and Andrija Nakić, "Rakitnica, Dazlina i Velim – ostaci nekadašnje obrane zapadnog dijela šibenskog distrikta" [Rakitnica, Dazlina, and Velim: Remains of the Former Defensive System in the Western Part of the Šibenik District], *Radovi Zavoda za povijesne znanosti HAZU u Zadru* 62 (2020): 113–38, https://doi.org/10.21857/yk3jwhx8j9; Josip Pavić and Andrija Nakić, *Mura Incognita: nepoznata utvrđenja Šibenika i okolice (istraživanja 2017.–2021.)* (Šibenik: Javna ustanova u kulturi Tvrđava kulture Šibenik, 2021).

[7] Glavaš, "Čorićev toranj," 81.

[8] On the south-eastern façade, a Gothic coat of arms featuring a crenelated tower and the initials H.S. is traditionally associated with Jeronim de Saracenis, although the attribution remains uncertain. Interventions carried out in the 1980s added replicas and new corbels corresponding to the supports of the earlier projecting structures. Glavaš, "Čorićev toranj," 82.

[9] Juran, "Rodovi, obitelji i prezimena," 100.



Fig. 2. Aerial view of Čorić Tower and the surrounding residential fabric.

structure construction[10]. It is unclear whether the tower stood directly in the water at the time of its construction or was already connected to the mainland[11]. The physical layout featured a courtyard surrounding the structure, equipped with openings for firearms that cut through the courtyard wall near its corner. Later inventories from 1601 detailing the assets of the Giustiniani family from Šibenik, who inherited Jeronim de Saracenis' estate, confirm the complex consisted of a tower, court, house, and a mill located beneath the house inside the settlement, with the tower set inside a single courtyard[12]. An agreement followed in 1608 to build a house adjacent to Giustiniani's tower,[13] and by 1639, the Giustiniani estate in Vodice was explicitly divided into two parts: the portion next to the tower and the section behind the tower leading to the mill[14].

Besides Čorić Tower, the settlement began to be furtherly fortified in the second half of the sixteenth century. In the 1585 report, Orsat Giustiniani, Count of Šibenik, provided the Venetian Senate with a detailed

[10] Juran, "Rodovi, obitelji i prezimena," 87, 101–2.

[11] Glavaš, "Čorićev toranj," 88.

[12] Juran, "Rodovi, obitelji i prezimena," 106.

[13] Juran, "Rodovi, obitelji i prezimena," 107–8.

[14] Juran, "Rodovi, obitelji i prezimena," 111–12.



Fig. 3: Vodice. Exterior view of Čorić Tower.

account of the competition for the construction of the defensive works at Vodice, and also submitted further strategic recommendations. He clearly states his role in the finalization of construction of two stone watchtowers positioned on the northeastern and western perimeters of the settlement. These two structures were constructed to safeguard the MASIERA / SUHOZID where the gatehouse was situated and also the other two surrounding sides of the settlement against battery attacks // protecting the main inland gate and securing the outer wall encompassing the settlement. To lower state expenditure, Giustiniani mobilized local labour to quarry stone and burn lime mortar, restricting state costs to timber procurement and skilled masons' wages. Beyond these built structures, he proposed a plan to construct a defensive wall flanked by a small tower around the freshwater springs, thereby securing the settlement's water supply against siege tactics. The report underlines this works as follows:

„Però saria bene (per mia opnione) che fusse tirata una muraglia, che cingesse le boche delle dette acque, et da una parte fatta una toricella, che fosse per diffesa della detta muraglia, con la qual provisione saria facile, e securo il servirsi di essa acqua, anco in tempo de guerra, al qual luoco delle Vodizze) ho fatto fabricar doi guardiole de muro, cioè una sopra l canton da buora, et l'altra dalla parte del tramontar del sole, con le quali in ogni occasione si potria diffender da una battaria da mano, non solo la masiera, dove è la porta di sopra, ma anco le altre due parti, che circondano essa Villa; nella qual fabrica sì è speso pochissimo denaro di ragion della Serenità Vostra per, haver fatto far da quelli della Villa la calcara per le calcine, et preparato tutte le pietre, dimodo che non sì ha comprato altro, che li soli legnami, et pagati li maestri."

Orsat Giustiniani, Count of Šibenik, 1585[15]

Furthermore, by 1587, Count of Šibenik Luka Falier documented a dry-stone wall enclosing the settlement from the inland side. Falier also mentioned the Tower under control of the citizens of Šibenik, where was settled the night watch from the settlers of Vodice.

Dalla banda di qua verso Ponente sono le sottoscritte Ville. Vodizze lontana dalla Città miglia cinque, che fà fogi 44, anime 266, da fatti 59, è villa posta alla marina circondata dalla parte di terra con un muro di masiera, et vi è una

[15] Grga Novak, *Commissiones et relationes Venetae IV (1572–1590)* (Zagreb: Sumptibus Academiae scientiarum et artium Slavorum meridionalium, 1964),359–360.

Fig. 3. kaštel Vrpolje, pogled na ostatke i cisternu (foto: I. Glavaš).

buona, et bella torre delli Giustiniani Cittadini di Sebenico, dove quelli della Villa la notte fanno la guardia. Quivi alla riva del mare sorge un'acqua dolce così abondantemente et in gran copia che oltra il bisogno delli habitatori di detta Villa, et altri loghi del territorio et delle Galee, che ivi vanno a farne, serve anco per uso di tutta la Città, che vi è priva, come più a basso particolarmente si tratterà per esser cosa molto importante.[16]

Relatione di ser Nicolò Bragadin ritornato di conte di sebenico letta nell'eccellentisimo collegio à 18 decembre 1595.

Tra tutte le Ville de quel Contado non è la più utile, et sicura delle Ville delle Vodizze, sicura per esser ridotta al lido del mare, et circondata da una buona masiera. Utile perché nella città, ne in tutto il contado è altra aqua Viva della quale non solamente tutto il territorio se ne serve, ma ancora le galere della Sertà Va, non ha altro loco più commodo per potter far Aqua, però giudico che sarà sempre bene, che quella torre, che d'ordine suo è stata accomodata, sia conservata, perché mentre che quella torre starà in piedi tengo per fermo che la Villa, l'Aqua, et li habitanti potranno benissimo presservarsi da ogni incursione de male genti.[17]

1607, 25. Nouembre. Letta in Collegio relatione di ser Francesco Corner ritornato de Conte et Capitano di Sebenico.

Ho anco fatto allargare et serrare di muro la villa delle Vodizze dentro la quale v' è un sorgente d'acqua viva, che come è unica tra la città et il contado così è quella che indenficientimente supplisce al bisogno di essa et dell'armata ancora quando si trova in quei porti; ;Essendosi contentati quei villici da me eccitati, et persuasi con un poco di aiuto, che si gli è dato di farne l'opera colla quale resteranno anco sicuri d'ogn'incursione de Turchi alla quale erano da quando in quando sottoposti.[18]



Fig. 4: Vodice. Exterior view of Čorić Tower, showing the wall surfaces and surviving supports of the former defensive projections.

An official military report was written by Alvise Malipiero, *Provveditore straordinario*, to the Venetian

[16] Novak, Commissiones et relationes Venetae IV, 396.

[17] Grga Novak, *Commissiones et relationes Venetae V (1591–1600)* (Zagreb: Sumptibus Academiae scientiarum et artium Slavorum meridionalium, 1966), 145.

[18] Grga Novak, *Commissiones et relationes Venetae VI (1588–1620)* (Zagreb: Sumptibus Academiae scientiarum et artium Slavorum meridionalium, 1970), 141.



Fig. 5: Vodice. Two aerial views of Čorić Tower and its adjoining courtyard within the present urban fabric.

government on June 22, 1646[19]. Providing a firsthand account of two successful military engagements against a massive invading Ottoman army led by the Pasha of Bosnia, it details how outnumbered Venetian forces, supported by local militias and naval galleys, successfully defended the territory in skirmishes near Šibenik and Vodice. The author uses these victories to urgently request a permanent armed galley, funds, and troop reinforcements from the Venetian Senate to secure the region against future attacks:

The report openswith a warning that the Pasha of Bosnia is advancing toward Venetian-controlled Dalmatia with an estimated 20,000 combatants (mostly cavalry) and eight cannons. The Ottoman forces have halted at Knin and Ostrovica, posing a direct threat to key Venetian coastal strongholds like Zadar, Novigrad, and Šibenik. A massive Ottoman army advanced to within two miles of Šibenik. The Counter-Attack: Encouraged by Governor Malipiero, local townspeople, despite being vastly outnumbered, decided to take the offensive. *Provveditore* Morosini arrived in the harbour with a Venetian galley, using its position to boost local morale and provide tactical support. The defenders launched a surprise counter-attack, driving the Ottoman troops four miles back into their own territory, inflicting heavy casualties, and suffering only one minor injury on the Venetian side.

[19] Archivio di Stato di Venezia (ASVe)/Venetian State Archives: ASVe, Senato, Dispacci, Dispacci dei rettori Dalmazia 51 (1646-1647), 22 June 1646. The archival research was part of research funded by the project HEPHAESTUS, HEritage Protocols for ArcHitecturAl European cross-border Sites Evaluation Studies, funded by the European Marie Skłodowska-Curie programme under Horizon 2023, Research and Innovation Staff Exchange (RISE), Proposal No. 101182877. The project, with a duration of 48 months (2024–2028), involves the participation of academic partners: the Department of Architecture of the University of Florence (Italy, coordinator Prof. Sandro Parrinello), the Department of Civil Engineering and Architecture of the University of Pavia (Italy), Gdańsk University of Technology (Poland), and Bochum University of Applied Sciences (Germany); and non-academic partners: Metaheritage (Italy), Fundacja to Get There (Poland), Urban Culture Institute (Poland), Institute of Art History (Croatia), and the Fortress of Culture Šibenik (Croatia).

Malipiero sent fifteen villagers from Vodice into the countryside to capture an Ottoman prisoner for intelligence. The daring group travelled near Ražanac, killed two prominent Ottoman leaders, and brought back three prisoners. Enraged by the raid, the Pasha dispatched a massive force of apparently over seven thousand troops to hunt down the villagers. About forty local defenders were cornered and put in a desperate position. Just as the situation grew critical, armed Venetian boats and the galley of Signor (D)Aulo arrived rapidly. They bombarded the enemy with artillery fire, forcing the Ottomans to retreat. The village was saved. The local fighters killed twenty enemy soldiers (recovering six enemy heads) and wounded over fifty, while again suffering virtually no casualties themselves.
Malipiero argued that these battles prove how vital it is to have a permanently stationed galley in Šibenik. A fast-moving warship was required to quickly reach coastal danger zones before damage could have been done. He concluded the report by asking the Venetian Senate for money and troop reinforcements. Conclusively, he promised that if Venice provides the requested financial support and military backing, he will successfully defend the region and protect the Republic's honour and reputation.
Furthermore, the Venetians made two unsuccessful attempts to capture the Rakitnica Fortress in 1646 and 1647. A more favorable opportunity arose immediately after the second attempt. In spring 1647, while the Venetians were pillaging the nearby settlement of Velim, the Ottoman garrison stationed at Rakitnica left the fortress to help the town. This left the fortress undefended. However, the two forces failed to encounter one another: the Ottomans arrived in Velim only to find that it had already been ransacked, while the Venetian troops occupied the abandoned fortress. When the Ottoman soldiers returned to Rakitnica, the Venetians successfully repelled them. Capturing the fortress was



Fig. 6: Vodice. Stone coat of arms on Čorić Tower, bearing a crenellated tower and the initials H.S.; its traditional association with Jeronim de Saracenis remains uncertain.

extremely beneficial to Šibenik, as its presence under Ottoman control had frequently caused disturbances in the surrounding territory, even during periods of peace. Moreover, its elevated position provided a clear view of the city's port, making it a strategically important site for observing and monitoring the movements of Šibenik's inhabitants. After Venetian authority was restored, part of the estate in the village was returned to the Simonić family, while the ruins of the fortress were entrusted to villagers from Vodice. Rakitnica itself never fully recovered as a settlement, and by the 19th and 20th centuries, only a few houses remained[20].

[20] Pavić, Glavaš, and Nakić, "Rakitnica, Dazlina i Velim," 117.

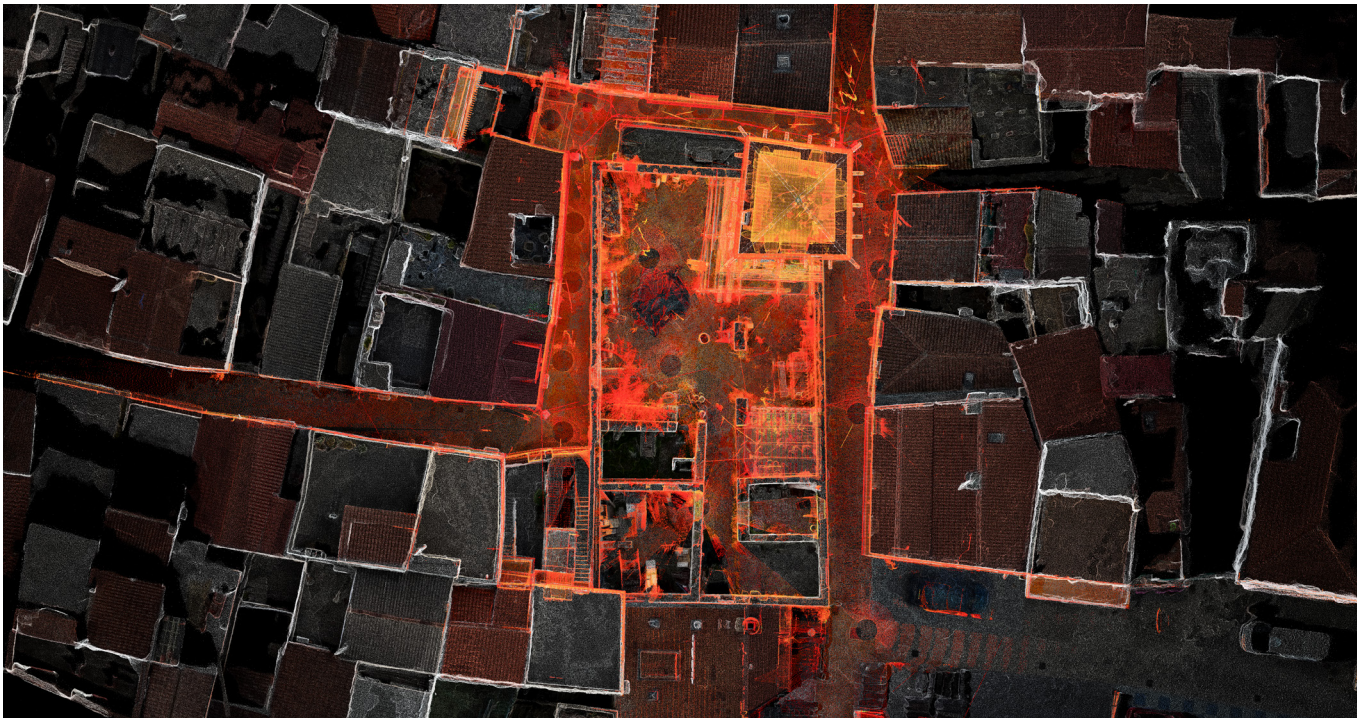


Fig. 7: Vodice. Plan view of the integrated point cloud.

Digital Documentation

The digital documentation and the formal and typological analysis of the fortified structure of the Vodice settlement focused on the remains of Čorić Tower, a significant example of military architecture in the Dalmatian territory. The survey was carried out to deepen the architectural and technological understanding of the tower, which, although already the subject of previous studies[21], lacked a comprehensive morphometric documentation describing its structures. From the data acquired on site, high-resolution three-dimensional digital models were produced, through which it was possible to analyse the construction techniques, the historical evolution and the state of conservation.

One of the main difficulties encountered during the investigation was the presence of an active restoration site on the building: the tower was partly inaccessible and surrounded by scaffolding, building materials and machinery. Only through careful planning of the survey operations and accurate data post-processing was it possible to obtain reliable digital models and graphic drawings.

Following a preliminary comparison with the historical

[21] Previous studies on the town of Vodice and on Čorić Tower include: Karmela Juričev-Martinčev, *Izazovi i problemi očuvanja graditeljske baštine* (master's thesis, University of Zagreb, Zagreb, academic year 2023/2024); Tončika Cukrov, "Vodice – od kaštela do modernoga primorskog naselja," in *Proceedings of the conference 3° Congresso degli storici dell'arte croati* (Zagreb: Institut za povijest umjetnosti, 2013).



Fig. 8: Three-dimensional view of theintegrated point cloud of Čorić Tower and the adjoining courtyard.

cartography of Vodice[22], the architectural survey was planned according to the spatial configuration of the site. Once the most suitable data acquisition instruments had been selected[23], the survey campaign was carried out with the aim of recording the physical, geometric and chromatic conditions of the structure. The range-based survey was performed by laser scanning, using a static instrument, the Leica BLK360; a total of thirty scans were acquired, from the outer perimeter of the enclosed courtyard to the interior of the tower.

The survey of the interiors made it possible to analyse the distribution of the tower's rooms and the relationship between its levels, already partly legible from the analysis of the external masonry facings. The ground floor and the first floor, currently connected by a wooden ladder, are covered by vaults oriented perpendicularly to one another, while the top floor, inaccessible and lacking any vertical connection, is covered by a nineteenth-century pitched roof that has recently been restored[24].

The thirty scans acquired with the Leica BLK360 were pre-aligned on site using Leica Cyclone FIELD 360; registration was then completed and optimised by

[22] The analysis of the historical cartography drew on the Arcanum Maps database (for the Habsburg-era cadastral maps) and on the Geoportal of the State Geodetic Administration of the Republic of Croatia (Geoportal DGU – Državna Geodetska Uprava).

[23] The survey was carried out with two categories of reality-based data acquisition devices: range-based systems (laser scanner) and image-based systems (drone and camera).

[24] The first floor of the tower should be considered as divided into two levels since, on the basis of evident marks on the internal masonry, it is possible to hypothesise the former presence of a timber mezzanine, currently absent because of the restoration works.

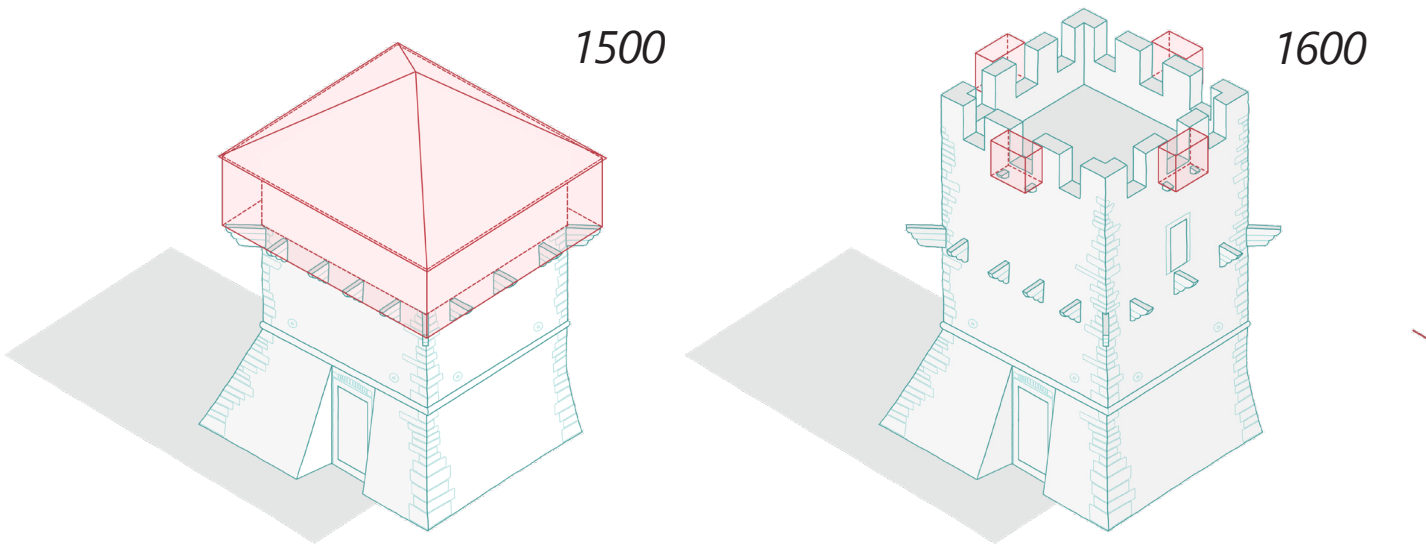


Fig. 9: Čorić Tower, Vodice. Interpretive reconstructions of successive configurations, schematically labelled 1500, 1600 and 1800, illustrating changes to the tower's volume, defensive projections and roof.

means of control points in Leica Cyclone CORE. The laser scanning survey produced a dense point cloud of 83.490.699 points, with a mean error of 0,001 m.

Alongside the range-based laser scanning survey, a photogrammetric survey campaign was conducted using ground-based and aerial image-based equipment, in order to obtain a three-dimensional model capable of recording the shapes, the surface characteristics and the parts of the building that are difficult to reach from the ground. The use of a drone[25] was essential: through manually piloted flight plans with circular trajectories at varying altitudes and camera tilt angles, it enabled the complete acquisition of the geometry of the roof and of the upper levels. A first digital model was generated from the aerial images and subsequently integrated with 1115 images[26] acquired through terrestrial photogrammetry, carried out by means of close-range, partially overlapping image sequences taken from different positions and angles.

The use and integration of two different image-based systems made it possible to create a three-dimensional photogrammetric model composed of a total of 1329 images. The large amount of input data and the proper alignment of the drone images with the terrestrial images led to the production of orthophotos, which were used to document the masonry facings and some architectural details of the tower with high accuracy.

Once processed, the range-based and image-based three-dimensional point clouds were aligned within a common reference system in Reality Capture. To carry out this operation, the photogrammetric point cloud had to be scaled to the laser scanner point cloud by means of morphological control points. This process, performed in CloudCompare[27], allowed the data to be

[25] The drone used was a DJI Mavic mini 2.

[26] 4000 × 6000 pixels, 300 dpi.

[27] When the acquisition campaign is carried out without physical markers, CloudCompare proves to be the most efficient software for orienting and scaling the photogrammetric model on the laser data. The point pairs picking function makes it possible to compute the initial scale factor

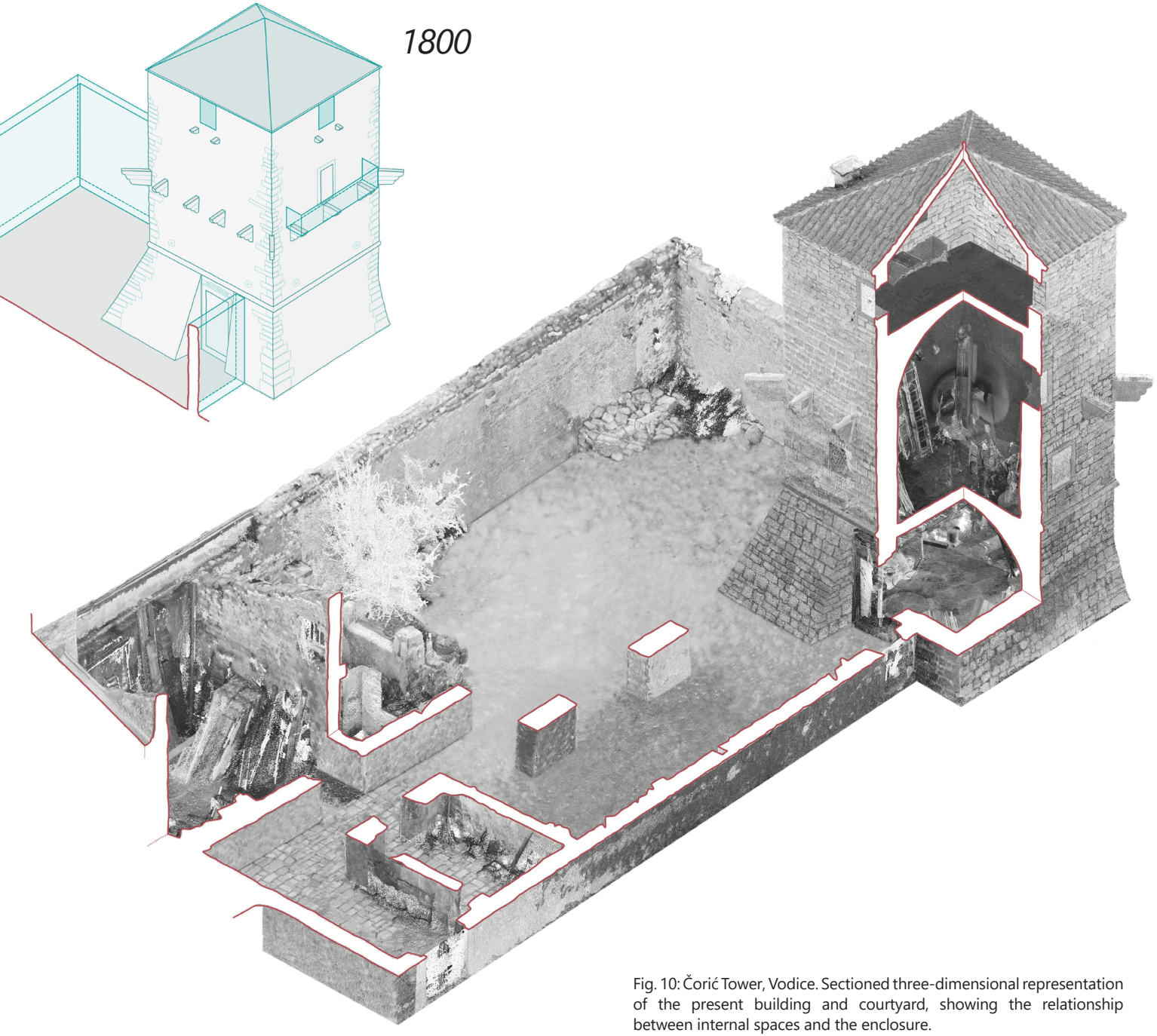


Fig. 10: Čorić Tower, Vodice. Sectioned three-dimensional representation of the present building and courtyard, showing the relationship between internal spaces and the enclosure.

aligned with a mean error of 0,025 m. The final result is a single hybrid model that combines the geometric accuracy of the laser scanner data with the informative and chromatic quality of the photogrammetric model.

Once the survey campaign and data processing had been completed, the final phase of the research focused on the graphic representation of the building. Using various drawing software packages and graphics tablets, both traditional two-dimensional drawings and more complex three-dimensional representations were produced, which played a decisive role in the analysis, critical interpretation and reading of the architectural structure. The analysis of these drawings revealed several material traces that proved decisive in formulating and validating hypotheses on the historical evolution of the tower. The case study has in fact gone through several historical phases, marked by sometimes profound transformations, which were reconstructed through three-dimensional axonometric representations.

The original configuration of Čorić Tower featured a battered base, gunports and a parapet projecting on corbels, equipped with machicolations and protected by a hipped roof. Following the fall of the nearby fortress of Rakitnica (1571), the tower remained the sole stronghold of the district and was raised to reinforce its defenses: a new vault was built to support the added level, which was crowned by a crenellated parapet with a bretèche on each side, of which only the lower corbels survive today. Once the Ottoman threat had ceased, during the nineteenth century the tower lost its military function and became a dwelling: the crenellations were walled up to build a new hipped roof and, on the seaward façades, the bretèches, by then obsolete, were converted into windows. Finally, an enclosure wall was built against the south-western side; it still bounds a courtyard already recorded in the Habsburg cadastre of 1825[28].

To validate the hypotheses on the historical evolution, the study of sections, plans and exploded views was fundamental, as it made it possible to read the relationship between interior and exterior spaces and to investigate the spaces and volumes of the tower.

As the last phase of the survey campaign, the graphic representation of the acquired data not only helps to highlight the historical and architectural importance of Čorić Tower but also proves essential for recording its physical condition over time, creating a permanent documentary archive[29]. This is of fundamental importance since the integrity and authenticity of the monument, part of the Croatian architectural heritage, are threatened by inadequate protection and by recent restoration works of little fidelity, which have compromised its appearance and authenticity.

by manually identifying homologous geometric features.

[28] On the loss of military function and the subsequent "residential" conversion of medieval structures, see Sandro De Maria, *Riuso e trasformazione dell'antico e del medievale nell'architettura moderna* (Bologna: Clueb, 2003).

[29] On architectural survey as a process of knowledge and of archiving the physical and historical memory of architecture, see Mario Docci and Diego Maestri, *Il rilevamento architettonico: Storia, metodi e disegno* (Rome–Bari: Laterza, 1984).

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THE CITADEL AND TOWER IN MARINA

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Historical development and archaeological evidence

The settlement of Marina is situated in the central part of the Bay of Marina, approximately 12 km west of Trogir, near the present-day boundary between Split-Dalmatia and Šibenik-Knin counties. In the Middle Ages, this area presented western part of the communal territory of Trogir. Also it was associated with the historical settlement known as Bosiljina which is first mentioned in the 11th century. Wider area of Bosiljina was closely connected with Drid, an ecclesiastical parish documented at the Synod of Split in 1185[1]. Medieval documents indicate that control over this fertile territory and its pastures was a recurrent source of disputes[2]. The development of Marina as a fortified coastal settlement should be understood in the context of the political and military transformations that affected Dalmatia during the 15th and 16th centuries. In 1409, Ladislaus of Naples surrendered Dalmatia to Venice, marking the beginning of a long-lasting Venetian rule over the region. In the mid-15th century, the Ottoman army appeared at the borders, triggering a migration of the population from old villages. These villages, previously situated mostly on the slopes of hills, were abandoned in favour of urbanistically planned, fortified settlements located right on the coast. The sea could have provide a vital route of retreat for the fleeing population during Ottoman sieges. Consequently Venetian authorities permitted certain patricians to construct fortified castles (in croatian: *kašteli*) to protect their estates and inhabitants along the stretch from Split to Marina. Within this wider process, fortified complexes served both to protect local populations and to secure ecclesiastical and patrician's property[3].

Settlement of Marina is representing the westernmost fortified settlement within the Trogir territory. Defensive character of the settlement is arranged around two architectural structures: bishop's tower at the north, originally built in the sea and citadel located immediately south. These two structures should be considered as a single defensive complex. Their spatial relationship and communication between their entrances is essential for understanding the defensive organisation of the settlement. New archaeological survey from 2021 provided new and valuable evidences giving better understanding of their use. Excavations revealed a material remnants of drawbridge elements on both citadel and bishop's tower but also a somewhat later fixed structure of the bridge.

[1] Tonči Burić, "Srednjovjekovna Bosiljina (topografsko-arheološka skica)," *Starohrvatska prosvjeta* III, no. 36 (2009): 284.

[2] Anita Gamulin, "Marina, Povijesni izvori i prostorni razvoj utvrđenog naselja," *Vartal: časopis Matice hrvatske Trogir za kulturu, društvena i gospodarska pitanja*, no. 1–2 (2013): 27–28.

[3] Vjeko Omašić, *Kaštela od prapovijesti do početka 20. st.* (Kaštela: Muzej grada Kaštela, 2001), 151–52.



Fig. 1: Marina. Aerial view of the tower and harbour, showing the building's present relationship with the waterfront.

In 1495, the bishop of Trogir, Franjo Marcello, received permission from the count of Trogir, Alviz Barbarigo, to erect a building in the Bay of Marina to protect its inhabitants[4]. Bishop Marcello also built the church of St. Marina at the head of the Marina bay. There are indications that church of St. Marina was erected on the remains of an earlier structure. Titular name of St. Marina replaced the old name of the village Bosiljina in the Early Modern Period, ultimately giving the settlement its current name, Marina[5]. The bishop's tower was erected on a coastal cliff completely surrounded by the sea as a defensive feature. This square, four-storey tower built in stone masonry remains the main spatial landmark of Marina even today. The photograph of the tower prior to its 1970 radical restoration shows the architectural layout following the historical reconstruction by bishop Ivan Vidović in the 18th century. Namely, during the Cretan War (1645.–1669.), Marina suffered heavy losses due to Ottoman attacks. The most famous was the siege by the Bosnian Pasha Seid Ahmet in 1657 when tower was partially devastated in purpose to prevent it from falling into enemy hands[6]. In 1717, the tower was restored by

[4] Gamulin, "Marina," 38.

[5] Burić, "Srednjovjekovna Bosiljina," 287.

[6] Gamulin, "Marina," 49.



Fig. 2: Marina Tower. Historical (left) and present-day (right) views, showing changes to the upper level following restoration and adaptation.

bishop Vidović, as evidenced by the inscription above the southern tower gate. The intervention included changes to the roof and upper termination of the building. The original defensive construction on machicolation was replaced by a gabled roof. The current, recent state of the tower is a result of the general restoration in 1970, led by conservator Stanka Machiedo[7]. The tower was returned to its assumed original state, reinstating the hipped roof and the machicolation. Today, conservation standards are different, and it is questionable whether such a radical restoration would be implemented. However, this example also allows us to track the history of conservation-restoration thought and practice in Croatia. After the 1500 began a construction of fortified enclosure immediately south of tower and it has been known as the citadel. The citadel has a rectangular plan measuring approximately 37 × 28 m. Its walls were constructed of roughly cut stone and originally incorporated towers at the southeastern and southwestern corners. The defensive walls of the citadel reached approximately 6.20 m in height and terminated in a crenellation (merloned parapet) associated with a wooden wall-walk and protective merlon shutters (manteletti). Several features of the surviving citadel walls help reconstruct its original

[7] Stanka Machiedo, "Rekonstrukcija i adaptacija kule u Marini," *Viniščanski zbornik*, no. 2 (2008): 47–54.

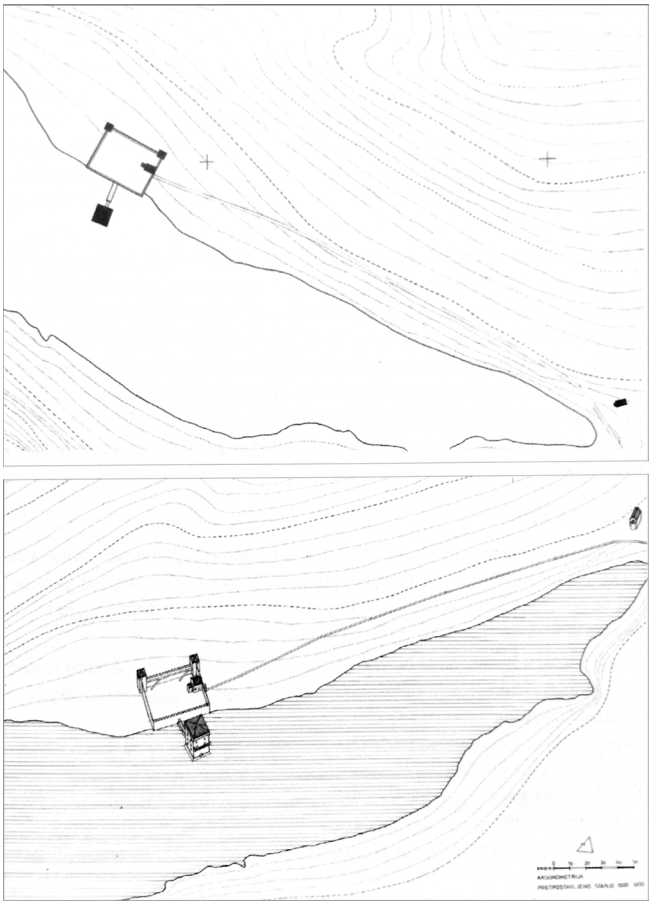


Fig. 3: Marina. Reconstructive drawing illustrating a proposed historical configuration of the fortified settlement.

defensive arrangement[8]. Remains of the crenellated upper termination are particularly legible along the eastern citadel wall, while sections of projecting stone consoles associated with a former wooden wall-walk survive in some places[9]. The entrance to the Citadel is today located on the western side and is marked by the coat of arms of bishop Marcello. It is sheltered by



Fig. 4: Cadastral plan of the settlement, showing the building plots, the citadel and the tower.

the remains of a bretesche, an architectural element above the gate used for pouring hot oil or throwing stones at the enemy. During the Baroque period, the facade of the Church of St. John was integrated into the entrance facade of the Citadel adding another phase to the complex's architectural history. The southern wall of the Citadel (which was originally the only citadel's wall flanked by the sea) was completely altered by the later construction of houses. This is the reason that today there is no remains of citadel's northern gate but originally, northern citadel's gate must have led across a bridge toward the tower. During the 16th century, a settlement developed around the tower and citadel.

[8] Gamulin, "Marina," 70–76.

[9] Gamulin, "Marina," 70–76.

This settlement was enclosed by an additional defensive perimeter, described as a polygonal arrangement with square towers at its corners[10]. Only fragments of this outer defensive system survive today but outlines are clearly outlined at 1831 cadastral map. The complete Marina's fortified complex therefore represents several overlapping levels of defence: the tower, the citadel and the fortified enclosure surrounding settlement. The two principal structures of bishop's tower and citadel should consequently be interpreted as parts of a larger defensive arrangement. Their proximity alone does not establish how they were connected; that question must instead be addressed through the relationship between the surviving architectural fabric, the archaeological remains and the historical documentation.

During the waterfront development project in 2021, the Ministry of Culture, Conservation Department in Trogir ordered an archaeological excavation of the southern forecourt of the tower. The excavation was directed by an archaeologist Tomislav Jerončić under the supervision of Ministry's senior expert advisor-conservator Marijeta Babin. The excavation exposed two parallel walls extending for approximately 6 m (and probably beyond but the excavation area was restricted due to the need to maintain continuous vehicular traffic). The walls were constructed of stone blocks with an internal filling of reddish clay (fig. 8). Their external faces were inclined outwards. The dimensions of the two walls differ. The northwestern wall is 0.75 m wide, with a 1 m wide footing. The southeastern wall is 1–1.2 m wide, with a footing of 1.7 m. It is assumed that this wider wall was exposed to stronger wave action, which is why it was built more robustly.

By removing the embankment fill between these two walls, two stone pillars were found driven vertically into the muddy bottom. They are 35 cm wide each and squared in section but their total size was not determined as we did not want to extract them from the mud. In any case, we established that they were placed in this manner with a clear structural intention. The position and deliberate perfectly vertical installation of these stone pillars shows that they were not simply loose building material or displaced stones. Their precise role must be evaluated in relation to the other features identified at the site.



Fig. 5: Marina. The façade of the Church of St John, incorporated into the entrance front of the citadel during the Baroque period.

The small stone corbels (consoles) located beneath the tower gate[11] directly correspond in elevation to the pillars driven into the mud— they are at the same absolute elevation. In the photograph there are presented three elements that are in direct correlation: the two pillars located 4.2 m away from the main facade,

[10] Gamulin, "Marina," 43.

[11] Zorislav Horvat, "Ulazi u burgove 12.–15. st.," *Prostor* 6, no. 1–2 (1998): 44.



Fig. 6: Marina. Aerial view of the citadel and adjoining settlement, clearly showing the archaeological excavations in front of the tower.

the small stone corbels below the gate at the same absolute height, and the openings above the gate that served as slots for lowering the bridge chains—likewise located at a height of 4.2 m from the small stone corbels below the gate. The relationship between tower slots, the consoles beneath the doorway and the stone pillars in the excavated area forms the basis for interpreting the remains as parts of a drawbridge mechanism (ponte levatoio). Stone pillars served as a support for the bridge in its lowered position. Such supports and are called 'battiponti',[12] named after the sound of the wooden bridge hitting the pier. In Marina case the permanent part of the bridge ('ponte morto') was likely made of wood which is why no traces of it were found during excavation. The defensive structure of drawbridges was invented in 12th century[13] and Martini Francesco di

[12] *Vocabolario Treccani on line*, s.v. "battiponte," accessed October 12, 2026, https://www.treccani.it/vocabolario/battiponte/.

[13] Giorgio Ponzio, "Brevi note sui ponti levatoi con riferimenti a Exilles e Torino," *Quaderni di Forte Bramafam* (February 2016): 1.



Fig. 7: Marina. Archaeological investigations of the area in front of the citadel and tower, with plans and photographs of the excavated structures discussed in the interpretation of the access system.

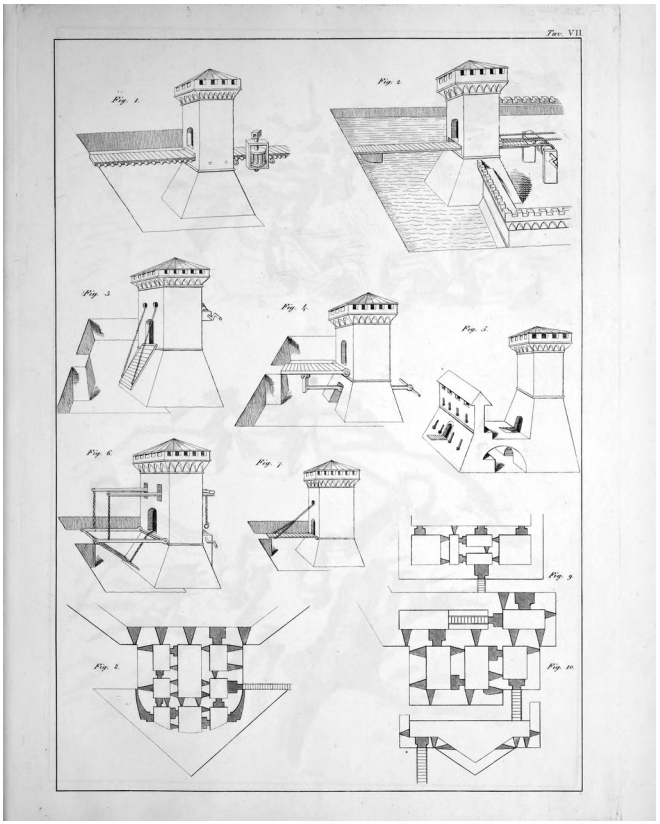


Fig. 8: Francesco di Giorgio Martini, studies of fortified towers and their access systems, with perspective views and plans. Plate VII from Trattato di architettura civile e militare, con dissertazione e note per servire alla storia militare italiana, vol. 3, Atlante (Turin: Tip. Chirio e Mina, 1841). Source: Wikimedia Commons.

Giorgio gave first typology which can correlate with the Marina case[14].

Based on the correlation between the western wall and the pillar, we conclude that the wall was built in a later period, as it "enveloped" the pillar during its construction. Consequently, we date the pillars to the period before the construction of the two walls. We conclude that the fixed construction of the masonry parallel walls was built later, probably during bishop Vidović's renovation. Additionally, it is probable that these walls were vaulted with timber structures that formed the walking surface of the bridge[15].

Archaeological excavations were also undertaken in the area immediately adjoining the southern side of the complex, in front of the citadel[16]. Here, the excavations revealed a situation described as nearly identical to that found south of the tower-the double walls of the fixed bridge and even the two stone pillars that were part of the drawbridge structure. The only difference is that today the facade of the citadel has been remodelled so no other elements of the drawbridge have been preserved. Interestingly, one pillar has distinct traces of mooring. This correspondence is central to the interpretation of the site. The repetition of a comparable structural arrangement at the two ends of the connection suggests that the bridge system was not an isolated feature associated exclusively with the tower. Rather, the evidence supports the possibility that both fortified structures had their own movable bridge sections, connected by an intervening fixed passage.

In conclusion, we can state that the citadel and the tower were connected by a system of two drawbridges, which likely shared a fixed wooden bridge in between. The precise dimensions and construction of this intervening section remain uncertain because the presumed wooden superstructure which has not survived. The archaeological evidence suggests that the overall historical bridge system underwent at least one significant modification. A later phase is represented by the two parallel masonry walls. The masonry may have

[14] Francesco di Giorgio Martini, *Trattato di architettura civile e militare*, ed. Cesare Saluzzo (Torino, 1841), 23.

[15] Tomislav Jerončić, "Izvješće o zaštitnim arheološkim istraživanjima pretprostora Kule u Marini" (unpublished archaeological report, Split, March 2021), 1–24.

[16] Tomislav Jerončić, "Izvješće o zaštitnim arheološkim istraživanjima pretprostora Citadele u Marini" (unpublished archaeological report, Split, December 2021), 1–20.

supported a fixed bridge deck, possibly constructed of timber, thereby replacing the earlier configuration. The transition from movable to fixed and permanent bridge construction would represent an important change in the organisation of access between the two structures. The change may thus reflect an adaptation of the complex to different defensive requirements. We assume that this transition from movable to fixed bridge construction happened in the later Baroque period, when the threat of Ottoman raids ceased.

At the beginning of the 20th century, the coastline and the pier were remodelled by filling in the channel between the tower and the citadel.

The case of Marina illustrates how archaeological evidence can reveal relationships that are no longer legible in the standing monument. The tower and the citadel are often approached as separate architectural objects but the suggested reconstruction shifts attention from individual buildings to the circulation, access and defensive organisation of the complex as a whole. It should be noted that this kind of drawbridge construction stone pillars are not found anywhere near Marina in similar fortified settlements. Yet, we don't know whether they didn't exist as such or they were removed in later historical interventions. Similar drawbridge from the same period is reconstructed at fort 'Kaštilac' in Kaštel Gomilica[17] but with different fixed architectural elements. Furthermore even form of tower and citadel surrounded by third fortified settlement wall is very particular in the Marina case so we can perceive it as a response to the particular topography and defensive requirements of Marina.

Digital survey and typological comparison

Digital documentation of the fortified complex of Marina complements historical and archaeological investigation by recording its present configuration. The tower on the harbour waterfront and the nearby citadel are now embedded in the urban fabric: understanding them requires consideration of the geometry of the individual structures, the spaces connecting them, and their relationship with the bay. The survey provides a reference for observing these relationships and comparing them with the arrangements described in the sources.

The survey campaign focused primarily on the tower and extended to the citadel area to document the relationships between the elements of the defensive system and the surrounding built environment. The integration of terrestrial laser scanning with aerial and terrestrial photogrammetry made it possible to build a database of geometric and colour information from which representations at different scales could be derived.

The work forms part of a programme documenting several fortifications along the Dalmatian coast, surveyed using a common procedure based on TLS and UAV photogrammetry, supplemented by terrestrial photographic acquisition. This provides a basis for addressing a further question: which elements can be described and measured according to shared criteria, allowing structures with different dimensions, configurations, and transformations to be compared?

The comparison of Marina, Ćipiko and Vodice is a first application of this approach. Orthoimages of the selected elevations are used to examine overall dimensions, proportions, and the configuration of bases and elements such as corbels. The aim is to find references that can also be used for the other cases in the project, distinguishing directly comparable characteristics from those requiring a specific description.

The campaign was designed around a fast survey approach, based on the coordinated use of the instruments and ongoing checks during data acquisition. Surface accessibility and available lines of sight guided the use of range-based techniques using terrestrial laser scanning and image-based techniques using aerial and

[17] Katja Marasović, *Kaštelanski kašteli* (Kaštela: Muzej grada Kaštela; Split: Sveučilište u Splitu, Fakultet građevinarstva, arhitekture i geodezije, 2025), 158–59.



Fig. 9: Marina Tower. Exterior view of the terrestrial laser-scanning dataset, used as the geometric reference for the integrated survey.

terrestrial photogrammetry. The laser data served as the metric reference for scaling the photogrammetric reconstruction, which was intended to document the structures and their surfaces.

The preliminary site inspection covered the tower, the citadel, and the accessible spaces around both structures to find scan stations and assess physical and visual obstructions. Reconnaissance extended to the settlement to see possible traces of the former fortified perimeter in the arrangement of the buildings. The observed alignments require verification against historical and cartographic documentation, as the site inspection alone cannot prove their origin.

The terrestrial laser survey was conducted using a Leica BLK360 G1[18]. The tower's location, with one elevation directly overlooking the sea, restricted terrestrial acquisition to three of its four façades. Scanning also covered two elevations of the citadel: the one facing the tower and the adjacent elevation.

During acquisition, Leica Cyclone FIELD 360 was used for preliminary scan alignment and a first review of the point cloud. Viewing the result in the field made it possible to identify gaps and occluded areas and assess TLS coverage. This information directed attention towards the areas that were more difficult to document within the photographic campaign planned for the entire complex. The rapid survey approach thus relies on coordinating operations as data become available.

Photographic documentation was conducted using a DJI Mini 4 Pro UAV and two DSLR cameras, a Nikon D3500 and a Nikon D5100[19]. Aerial imagery covered the entire tower and the citadel area, including facades, roofs, and open spaces. This coverage documented both the configuration of the individual buildings and their spatial relationships, while also providing extensive areas of overlap with the TLS survey.

At the tower, the UAV (Unmanned Aerial Vehicle) made it possible to capture the seaward elevation and observe the crowning structure from elevated positions. Attention was paid to architectural details and the surfaces above them, whose configuration required imagery from several viewpoints. Roof documentation completed the coverage of areas not visible from street level.

Terrestrial photographs contributed to the close-range description of masonry patterns, surfaces, and architectural details. Views from below were also needed to capture the undersides of the crowning structure, the spaces between the corbels, and portions concealed by projecting elements. Viewpoints were therefore selected

[18] Given the size of the site and the restriction of acquisition to external surfaces, sixteen scans were recorded. TLS data were acquired without colour information, limiting field operations and relying on photographic imagery to document the appearance of the surfaces. The scans provided the geometric basis for scaling the photogrammetric data.

[19] The material used in processing comprises 1,284 aerial images and 282 terrestrial images.



Fig. 10: Marina Tower. Photogrammetric representation of the tower, the citadel and sthe urrounding waterfront.

according to the geometry and visibility of the distinct parts of the building.

The combination of aerial and terrestrial imagery provided both overall documentation of the complex and close-range documentation of its elements. The colour information recorded in the images goes with the geometric reconstruction and allows materials, openings, and surface discontinuities to be recognised, supporting subsequent architectural analysis.

After the campaign, the TLS data were exported from FIELD 360 and imported into Leica Cyclone Register 360 for checking, normalisation, and validation of the registration. The registered point cloud was then transferred to Leica Cyclone Core for visualisation and later integration with the photogrammetric reconstruction.

The images were processed in RealityScan, with aerial and terrestrial imagery initially treated as two separate datasets. Image alignment and three-dimensional reconstruction were conducted for each dataset; the results were then combined into a common photogrammetric dataset. For the UAV point cloud, four control points were needed in the software to link the reconstructions of the citadel and the tower.

The resulting reconstruction represents the tower, the citadel buildings, and the surrounding open spaces. Moving from an overall view to detailed views of individual buildings allows the arrangement of volumes and the articulation of surfaces to be examined within the same three-dimensional environment.

The photogrammetric data were scaled in RealityScan by assigning the control points the coordinates of the corresponding points identified in the TLS point cloud in Leica Cyclone Core. The photogrammetric point cloud,

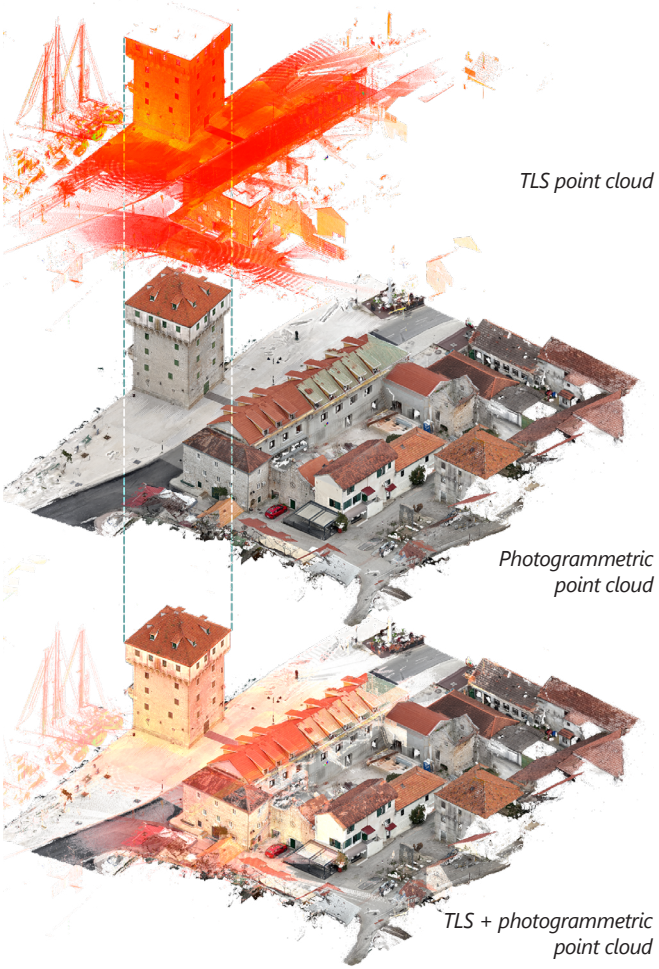


Fig. 11: Marina. Comparison of the terrestrial laser-scanning dataset, the photogrammetric dataset and their integration.

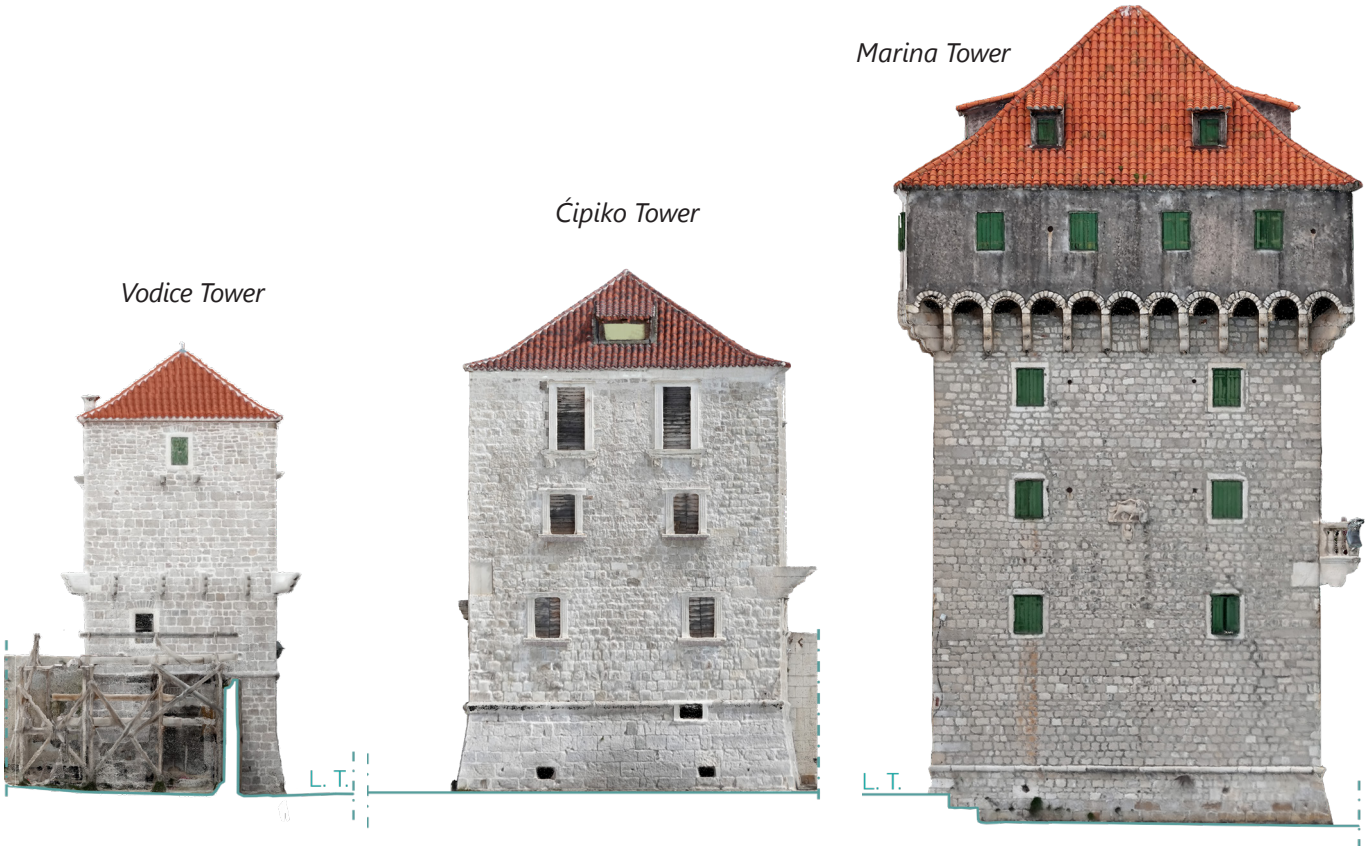
thus referenced to the laser-derived metric framework, was then imported into Cyclone Core and aligned with the TLS data.

Integration brought the data into a common reference system, although the scope for verification differs across the complex. Surfaces recorded by both techniques allow direct checks of correspondence; those documented exclusively through images, such as the seaward elevation, do not offer the same opportunity for comparison with the TLS data. This distinction informs the use of the resulting representations for measurement.

The database provides the starting point for architectural representation guided by the questions addressed in the study. Overall views allow the relationship between the tower, citadel, and harbour waterfront to be seen; views of individual structures allow the distribution of openings, the profiles of the base, and the articulation of the crowning structure to be examined. Three-dimensional documentation also makes it possible to check the elements seen in an elevation from different viewpoints.

Dimensioned orthoimages of the selected elevations were prepared for the comparison of Marina, Ćipiko and Vodice. The orthoimages were produced in Cyclone Core from the scaled photogrammetric data. These representations combine the appearance of the surfaces with dimensional references, so that the elements and levels to which the measurements refer can be identified. The parameters considered were overall height, the width of the tower body, width at the base, height to the lower edge of the selected corbels, and the inclination of the scarp compared to the vertical. Heights refer to the ground line shown in each drawing; widths refer to the sections found by the dimensions. The ground line was set up from the present ground level, while the angles were measured between the extended vertical line of the tower and its scarp.

The ratio of overall height to body width describes the proportions of the elevation, while width at the base and scarp inclination provide further information on its lower configuration. The height of the corbels finds the position of projecting elements that occur at distinct levels in the three cases. Their use as a geometric reference therefore requires them to be shown in the drawing, without assuming functional or chronological equivalence. Establishing a common comparative basis also requires a distinction between an absent element and one that cannot be seen. This distinction allows the description to be extended to different structures,



Parameter	Ćipiko	Marina	Vodice
Total height	16.9 m	27.8 m	15.4 m
Height to the lower edge of the selected corbels	6.4 m	15.6 m	6.7 m
Body width	10.0 m	13.7 m	6.7 m
Width at the base	11.0 m	14.0 m	8.4 m
Scarp inclination compared to the vertical	10°	14°	19° left; 11° right
Total height / body width	1.69	2.03	2.30
Height to corbels / body width	0.64	1.14	1.00

Fig. 12: Comparative elevations of Čorić Tower in Vodice, the Cippico Tower and Marina Tower, showing differences in overall proportions and the arrangement of architectural elements.

preventing a gap in the survey from being interpreted as an architectural characteristic. The comparison highlights differences between the absolute dimensions and the proportions of the elevations. Marina has the greatest height, at 27.8 m, followed by Ćipiko at 16.9 m and Vodice at 15.4 m. However, the ratio of total height to body width is highest at Vodice, where it reaches approximately 2.30, compared with 2.03 for Marina and 1.69 for Ćipiko.

The widths at the base and the inclinations of the scarps describe further differences in the configuration of the lower profiles. At Vodice, the angles recorded on the two sides differ and are kept separate in the comparison. These measurements refer to the portions represented and must be read in relation to ground level and surface visibility.

The position of the corbels also varies considerably. At Marina, the reference belongs to the continuous system of the crowning structure; in the elevations of Ćipiko and Vodice, the selected elements occupy an intermediate position. The comparison quantifies their position but must account for the different configurations of the systems to which they belong.

The comparison of Marina, Ćipiko and Vodice shows overall dimensions, the configuration of the base, and the position of the corbels as an initial set of references for the comparative documentation of towers. These references allow different structures to be described using common criteria, while the elements to which the measurements refer remain identifiable in the orthoimages.

The three cases show, however, that a recurring element does not necessarily play an equivalent role in the organisation of each building. The corbels, present at distinct levels and associated with different configurations of the elevations, prove that numerical comparison must be accompanied by an architectural identification of the elements concerned. Height and width describe the proportions of the elevations; examining the elements that articulate them makes it possible to specify which portions can be compared. This distinction can provide the basis for extending the comparison to the other towers in the project.

The resulting documentation provides a reference for the current condition of the structures, including the effects of their transformations. Relating this documentation to historical and archaeological research allows these differences to be examined without attributing them directly to the original configurations. The database thus makes measurements and representations available against which interpretations can be evaluated: each element included in the comparison can be found within the building and, where the sources allow, assigned to the phase to which it belongs.

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KAŠTEL GOMILICA BETWEEN HISTORY AND REPRESENTATION. MULTI-SCALE 3D PRINTING FOR READING FORTIFIED HERITAGE

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The Benedictine Estate and the Church of Saints Cosmas and Damian

The founders of Kaštel Gomilica were the Benedictine nuns of the Monastery of St Rainerius in Split. This female Benedictine monastery was founded in 1069 by Archbishop Laurentius, in order to provide, within his Split diocese, a place or "*portus femineo sexui perfectae salvationis*", intended for the religious life of women[1]. The monastery soon became haven for daughters of prominent Split families consequently bringing wealth, influence and landed possessions[2]. Within this context, considerable scholarly attention has been devoted to the monastery's estates, or better said royal grants that awarded the monastery with its early holdings in the area of present-day Kaštel Gomilica.

More specifically, the most contested documents were two eleventh-century royal charters through which the Benedictine nuns acquired the land on which they built the Romanesque Church of Saints Cosmas and Damian[3]. According to these documents, King Zvonimir granted the estate of Pustica in Lažani to the Monastery of St Rainerius and its nuns in 1076[4]. The grant was subsequently confirmed by King Stephen in Šibenik on 8 September 1089[5].

The charters survive in twelfth-century copies written in Beneventan script. The copy of King Zvonimir's charter is severely damaged and partly illegible; transcriptions of both documents published by Daniele Farlati in eighteenth century were therefore used to supplement the missing sections. A more complete copy of King Stephen's charter is also preserved among the manuscripts of the historian Ivan Lučić[6]. Daniele Farlati also records that construction of the Church of Saints Cosmas and Damian began with the permission of Archbishop Gaudius, who held office between 1138 and 1158, and that the church was consecrated in 1160

[1] Daniele Farlati, *Illyricum Sacrum, tomus tertius: Ecclesia Spalatensis olim Salonitana* (Venice: Apud Sebastianum Coleti, 1765), 139.

[2] Grga Novak, *Povijest Splita*, vol. 1 (Split: Matica hrvatska, 1957; 2nd ed., Split: Čakavski sabor, 1978), 565.

[3] The authenticity of these charters was first questioned by Viktor Novak, who argued that they were later forgeries produced by the nuns. His views were debated by M. Šufflay, F. Šišić and J. Nagy. See Viktor Novak, "Dva splitska falsifikata XII. stoljeća," in *Bulićev zbornik: naučni prilozi posvećeni Franu Buliću prigodom LXXV. godišnjice njegova života od učenika i prijatelja* (Zagreb; Split, 1924).

[4] Marko Kostrenčić, ed., *Diplomatički zbornik Kraljevine Hrvatske, Dalmacije i Slavonije / Codex diplomaticus Regni Croatiae, Dalmatiae et Slavoniae. Vol. I: Listine godina 743–1100* (Zagreb: Jugoslavenska akademija znanosti i umjetnosti, 1967), 169–70.

[5] Kostrenčić, *Diplomatički zbornik*, 188–89.

[6] Kostrenčić, *Diplomatički zbornik*, 169–70, 188–89; Vjeko Omašić, *Kaštela od prapovijesti do početka XX. stoljeća* (Kaštela: Muzej grada, 2001), 63–64.



Fig. 1: Kaštel Gomilica. Aerial view of Kaštilac and the adjacent settlement, showing the fortified islet and its connection to the mainland.

by his successor, Archbishop Absalon[7]. A residence for the nuns was erected beside the church, intended to extend the monastery and to accommodate the nuns during the harvest: "*cum domo ad dilatandum Monasterium, in qua ipsae Moniales tempore messis ac vindemiae pie habitarent*"[8]. The later discovery of a *capsella reliquiarum*, or small reliquary casket, within the church altar supports Farlati's account of the church's construction and consecration[9]. The Church of Saints Cosmas and Damian represents a characteristic rural type of Romanesque ecclesiastical architecture. The twelfth-century Romanesque church has a rectangular plan, with a shallow semicircular apse on the eastern side and a barrel vault originally supported by arcades articulated along the lateral walls[10].

[7] Farlati, *Illyricum Sacrum*, 172, 175, 180.

[8] Farlati, *Illyricum Sacrum*, 172.

[9] Joško Belamarić, "Capsella reliquiarum (1160.) iz sv. Kuzme i Damjana u Kaštel Gomilici," *Prilozi povijesti umjetnosti u Dalmaciji* 31, no. 1 (1991): 41–57.

[10] The remains of the original vault and the discovery of an altar support containing the reliquary help to confirm the church's initial architectural form. The original doorway in the western facade and the window in the apse have also been preserved. During the Gothic period, the building underwent several minor alterations, most notably the construction of a buttress surmounted by a bell gable beside the southern side of the facade. During a later Baroque renovation, the bell gable was transferred to the top of the western facade, and a roofed porch was added in front of the entrance. The original barrel vault was replaced with a timber ceiling, while the chancel screen separating the sanctuary from the nave was removed. Tonči Burić, "Romanička sakralna arhitektura u Kaštelima," *Vjesnik za arheologiju i historiju dalmatinsku* 115, no. 2 (2023): 622–24; Duško Marasović and Mario Sumić, "Sv. Kuzma i Damjan u Kaštel Gomilici," *Obnova baštine* 1 (1993): 1–11; Belamarić, "Capsella reliquiarum."



Fig. 2: Kaštilac, Kaštel Gomilica. Present view of the entrance tower (left) and historical view of the complex and its bridge (right), documenting changes in the waterfront setting.

The Foundation of Kaštilac

The early modern fortification phase began with a precisely documented administrative act. On 9 January 1513, the Benedictine nuns of Split submitted a request for permission to construct an offshore castle that would protect their estate and its inhabitants from Ottoman raids and plundering[11]. Their request followed numerous Ottoman incursions during the second half of the fifteenth century. These attacks prompted landowners to demand adequate protection for themselves but also their tenants, which the Venetian authorities—who had ruled Dalmatia since 1420—were unable to provide directly. The protection of the population is a frequent point in these requests for the construction of castles (with fortified settlements in some cases) in order to maintain agricultural production. In addition to burning and looting, the Turks often took the population into slavery[12].

Therefore, first fortified residence erected in the Kaštela Plain specifically for defence against the Ottomans was the castle of Coriolanus Cippico in present-day Kaštel Stari. Cippico financed its construction himself after

[11] Omašić, *Kaštela od prapovijesti*, 191–92; Katja Marasović, *Kaštelanski kašteli* (Kaštela: Muzej grada Kaštela; Split: Sveučilište u Splitu, Fakultet građevinarstva, arhitekture i geodezije, 2025), 117, 119.

[12] Katja Marasović, "Kaštelanski kašteli" (PhD diss., University of Zagreb, Faculty of Architecture, 2002), 15, 350–97.

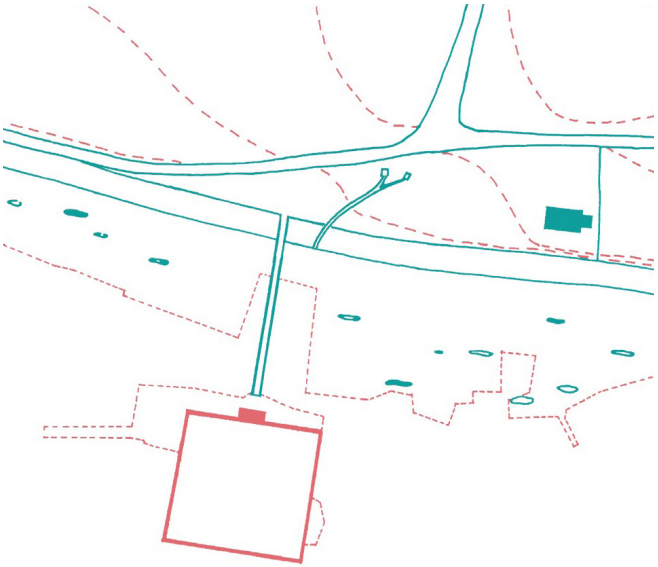


Fig. 3: Schematic reconstruction of Kaštel Gomilica in 1500, graphically reworked from the interpretation published by Katja Marasović in Kaštelanski kašteli (2025).

receiving permission from Troilo Malipiero, the count of Trogir, who issued the relevant charter on 16 August 1476[13]. Other landowners followed his example, and twenty fortified castles were eventually constructed in the Kaštela region during the period of Ottoman threat[14]. These included Kaštilac, around which the fortified settlement of Kaštel Gomilica developed.

To protect their estate, the nuns of the Benedictine Monastery of St Benedict in Split, represented by Abbess Jakobina Grisogono, petitioned the count and captain of Split, Bernardino da Riva, for permission to erect a castle "in the sea". Since his predecessors had already granted similar permissions, the count approved the nuns' request on 13 January 1513[15]. The proposed castle was to be constructed on a site where the inhabitants of the village of Kozice had apparently attempted to establish a fortification at an earlier date. Nevertheless, construction did not begin until 1529, when a building contract was concluded with the master builders[16].

Thus, the castle and fortified settlement became known as *Castel Abbatissa* or *Abbadessa,* named after its founder. Among the local population, however, the name Kaštel Gomilica prevailed, derived from the appearance and position of the artificially formed mound (Croatian: gomila) on which the castle was built. The castle itself became commonly known as Kaštilac[17].

Water and Defence in the Kaštela Region

Kaštel Gomilica was not an isolated case in its offshore setting, most of the castles in the Kaštela Bay were built on sea cliffs, reefs, islets or directly along the old coastline, and the village would develop on the mainland side[18]. After the Venetian authorities deemed the requested reefs and islets as of no use and value to the state they were granted to the noble petitioners[19].

The geomorphology of the Kaštela Bay area offers natural locations for the construction of this type of fortification[20]. In the preserved requests and approvals, the choice of a

[13] Omašić, *Kaštela od prapovijesti*, 153; Marasović, "Kaštelanski kašteli," 209; Marasović, *Kaštelanski kašteli*, 21, 23.

[14] Marasović, *Kaštelanski kašteli*, 21. Fortified settlements were erected around some of these castles to provide protection and refuge for the local population, eventually developing into the seven present-day administrative settlements of the City of Kaštela: Kaštel Sućurac, Kaštel Gomilica, Kaštel Kambelovac, Kaštel Lukšić, Kaštel Stari, Kaštel Novi, and Kaštel Štafilić.

[15] Omašić, *Kaštela od prapovijesti*, 191–93; Marasović, *Kaštelanski kašteli*, 119.

[16] Cvito Fisković, "Umjetnički obrt XV–XVI. stoljeća u Splitu," in *Zbornik Marka Marulića 1450–1950* (Zagreb: Jugoslavenska akademija znanosti i umjetnosti, 1950), 138, 159; Omašić, *Kaštela od prapovijesti*, 191–93; Marasović, *Kaštelanski kašteli*, 119.

[17] Omašić, *Kaštela od prapovijesti*, 193; Marasović, *Kaštelanski kašteli*, 117.

[18] Within the borders of surrounding mainland fortified settlement of Kaštel Gomilica, the Lucaris Tower was erected east of Kaštilac, standing just offshore and connected to the mainland by a bridge. Omašić, *Kaštela od prapovijesti*; Marasović, "Kaštelanski kašteli"; Marasović, *Kaštelanski kašteli.*

[19] See supplementary materials in Marasović, "Kaštelanski kašteli."

[20] Ivo Babić, *Prostor između Trogira i Splita: kulturnohistorijska studija* (Trogir: Muzej grada Trogira, 1984; repr., Kaštel Novi: Zavičajni muzej Kaštela, 1991), 11.

construction site in the sea for easier defence is in some cases explicitly mentioned as well as in the request for the construction of Kaštilac in Kaštel Gomilica[21]. In the case of Kaštel Štafilić, its builder Stjepan Stafileo, rejected the initial offer of the Trogir prince to build a castle on Trogir Velo Polje, considering the proposed construction unsuitable for the needs of both him and the local population as it would not serve the purpose it was intended for[22]. Almost two decades later, he received a new permit to build a castle on a sea cliff[23].

With this position, the sea creates another physical obstacle to attackers, and a drawbridge would completely cut off the castle from the mainland. Also, castles often had sea gates that would allow for the delivery of cargo as well as escape by boat in an emergency. Historical sources mention such cases of the population fleeing during Turkish attacks on castles[24]. The fortification strategies of the castles in the Kaštela area can also be compared to the defensive organisation of nearby Trogir, a city formed on an islet. The owners of a number of castles came from the Trogir nobility, among them Cippico, Vitturi, Andreis and Stafileo families. These are, therefore, people who lived in a city whose urban and defensive organisation was based for centuries on its island position, bridges, fortified gates and the control of narrow access routes.

However, this should not be taken as to imply that these castles were simply replicas of Trogir. We can speak of a clear institutional and social connection rather than a direct transfer of a specific architectural project. The similarity of Trogir, as well as other fortified sites within the Venetian Republic, is reflected in a common defensive logic, not only architectural forms. The castles in Kaštela region, in contrast, were a much smaller, private or church residential-defensive complexes, in which the same principles were applied in an area of only a few dozen metres. Trogir, as the geographically closest comparable model, particularly clearly demonstrates the defensive importance of the water belt. Foša, a narrow canal on the land side of the city, constituted one of the first obstacles to a possible enemy penetration. The importance of its maintenance is also evidenced by the report of the former Trogir prince Zacharia Orio, who warned of the need to regularly deepen the moat, remove silt and ensure the flow of water in order for the canal to maintain its defensive function in the long term[25].

Furthermore, water formed important part of the defensive systems of the fortified settlement, which, unlike most of the castles, were established on the mainland. Whereas the castles were generally built offshore and therefore surrounded by water, the fortified settlements strategically used numerous streams flowing from the north towards the sea. Their walls were often constructed alongside the streambeds, or artificial ditches were made, and water was diverted[26]. In the case of fortified settlement of Kaštel Stari two branches of the Fuležine stream descend from the north towards the sea along the eastern and western walls. It is not excluded that one of the branches was created artificially as part of the settlement's defensive system[27].

[21] See annexes 3, 9, 11, 12 and 13 in Marasović, "Kaštelanski kašteli."

[22] Janko Pera, *Povijest Kaštel Štafilića* (Kaštela: Matica hrvatska, Ogranak Kaštela, 1997), 19; Marasović, "Kaštelanski kašteli," 295.

[23] Omašić, *Kaštela od prapovijesti*, 159; Marasović, "Kaštelanski kašteli," 295.

[24] In 1512, on the night of June 13, the Turks attacked the Kaštel Cippico with 450 horsemen and 180 foot soldiers. The inhabitants defended themselves, sheltering in the castle, but were forced to flee on ships from Trogir that came to their aid. See Frane Ivasović, *Kaštel Stari: crtice iz njegove povijesti i života* (Split: Leonova Tiskar, 1940), 15; Katja Marasović, "Kaštel Cipiko u Kaštel Starome," *Prostor: znanstveni časopis za arhitekturu i urbanizam* 19 (2011): 34n20.

[25] Šime Ljubić, *Commissiones et relationes venetae*, vol. 2, Monumenta spectantia historiam Slavorum meridionalium 8 (Zagreb: Academia Scientiarum et Artium Slavorum Meridionalium, 1877), 152.

[26] Marasović, "Kaštelanski kašteli," 343; Marasović, *Kaštelanski kašteli*, 625.

[27] Marasović, "Kaštelanski kašteli," 211; Marasović, *Kaštelanski kašteli*, 383.

Although these castles and fortified settlements were built in response to the Ottoman threat, their defensive capabilities should not be equated with those of larger fortresses and cities, nor should it be assumed that they could withstand a larger attack by the Ottoman army. The disparity between attackers and defenders could have been great. Moreover, not only military-age men were inside the castles, but the entire population that sought shelter there. Although there were organised guards and armed companies in the castles, the available defence forces of each castle were limited and significantly smaller than those of the attackers[28]. It is precisely from this disparity that the reasons for building castles on a limited area of sea cliffs and islets can be most clearly seen, namely the sea position, the moat and the controlled entrance via the drawbridge are a way of compensating for the military weakness of these communities. Furthermore, the strategic use of natural streams and artificial ditches around the mainland fortified settlements reveals carefully conceived defensive system that made full use of the natural configuration of terrain that enabled small communities to defend themselves as effectively as possible.

Numbers of first settlers in Kaštel Gomilica presents a revealing example of small scale of population that these fortifications were supposed to protect. According to local tradition, seventeen families from the villages of Upper and Lower Kozice moved into Kaštilac of Kaštel Gomilica after the Ottomans destroyed their settlements in 1532[29]. By 1583, Kaštilac had approximately one hundred inhabitants[30].

Settlement Transformation

By the early seventeenth century, the population of Gomilica had grown to approximately two hundred inhabitants, and the confined space within Kaštilac had become inadequate. New inhabitants hence began settling on the mainland opposite the castle. In 1625, the expanded settlement was fortified according to a plan associated with Francesco Venier, the count of Split[31]. It was enclosed by substantial walls with three gates situated on the northern, eastern, and western sides. The principal northern gate, known as Fortin, was apparently additionally protected by a tower equipped with gun loops. Towers are also believed to have stood at the corners of the defensive walls[32]. The square in front of the bridge connecting Kaštilac with the mainland was known as the Brce, a name commonly used for similar public spaces in other Kaštela settlements. As in other fortified settlements of the Kaštela region, the waterfront remained unfortified because an attack from the sea was considered less likely. However, today it is not known if the walls of the fortified settlement were surrounded by artificial water-filled ditches or streams as was often the case[33].

Over time, starting in eighteenth century, additional building land within the protected area was created by reclaiming sections of the sea. Houses also began to appear outside the settlement walls even before the Ottoman threat had fully subsided[34]. Once that threat had passed, Kaštilac gradually lost its defensive function. Buildings erected alongside its fortification walls were enlarged until they rose above them, and new windows

[28] Marasović, "Kaštelanski kašteli," 23–24.

[29] Omašić, *Kaštela od prapovijesti*, 194; Marasović, "Kaštelanski kašteli," 81, 85; Marasović, *Kaštelanski kašteli*, 119.

[30] Marasović, "Kaštelanski kašteli," 81, 85.

[31] Omašić, *Kaštela od prapovijesti*, 194–95.

[32] Omašić, *Kaštela od prapovijesti*, 195; Marasović, "Kaštelanski kašteli," 97; Marasović, *Kaštelanski kašteli*, 121.

[33] Marasović, *Kaštelanski kašteli*, 121, 343.

[34] Marasović, "Kaštelanski kašteli," 99; Marasović, *Kaštelanski kašteli*, 125, 135.

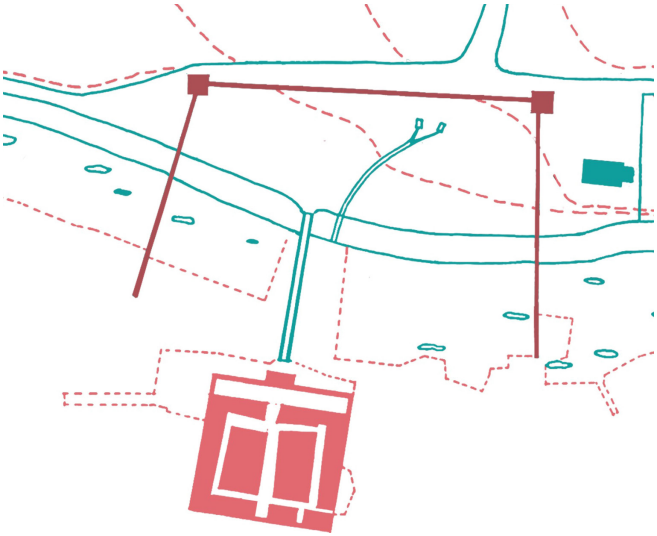


Fig. 4: Schematic reconstruction of Kaštel Gomilica in 1600, graphically reworked from the interpretation published by Katja Marasović in Kaštelanski kašteli (2025).

were opened towards the sea. The entrance tower was likewise adapted after it ceased to serve a defensive purpose[35].

Therefore, the history of Kaštel Gomilica can be viewed as a gradual transformation of a monastic estate into a fortified maritime settlement, a process that began within an older agrarian and sacred landscape and ended with the dissolution of the Monastery of St Rainerius under French administration in 1806[36]. Its specific character lies in this layered passage from monastic estate to defensive community.

Territorial and Stratigraphic Reading of the Building

Complementing the historical reconstruction, this reading of the building focuses on what Kaštilac preserves of its own phases, from its relationship with the site and the original defensive apparatus to the transformations that followed the loss of its defensive function. The original coastline, which can be reconstructed by studying the contour lines of the terrain, coincided with the present one to the west, ran along the northern side of the Brce within the settlement, and to the east followed the line of reefs below St Jerome. It is in relation to this line that the position of Kaštilac must be read. The castle was built on a mound previously prepared by the inhabitants of Kozice and described in the document of 1513 as "a rock, or a place built in the sea, below the village of Kozice itself" (*super scopulo seu loco in mari manufacto sub uilla ipsa Cosice*)[37].

The castle has a broadly quadrangular plan, with exterior dimensions of approximately 35.4 metres along the north–south axis and 37.2 metres along the east–west axis. These measurements correspond to approximately 20.5 by 21.6 fathoms, or 18.2 by 17.9 paces, and therefore broadly conform to the dimensions of eighteen by twenty paces specified in the original construction agreement[38].

Within the typological classification of the fortifications of Kaštela region, Kaštilac belongs to the category of a "tower with a fortified courtyard", together with similar structures in Kaštel Sućurac and Kaštel Kambelovac[39]. Kaštilac consisted of a defensive wall with a crenellated parapet and a timber wall-walk; the artificial nature of the islet on which it stands is confirmed by geotechnical

[35] In the cadastral register of 1769, it was recorded as the *Torre de Castello* and was already in private ownership. Several decades later, the Austrian cadastral survey of 1831 described it as a hayloft. In 1853, the tower was equipped with a clock and a belfry, marking its final transformation from a defensive structure into a prominent civic landmark. Marasović, "Kaštelanski kašteli," 91, 99.

[36] Marasović, *Kaštelanski kašteli*, 133.

[37] Marasović, *Kaštelanski kašteli*, 115-117.

[38] Omašić, *Kaštela od prapovijesti*, 192; Marasović, "Kaštelanski kašteli," 81; Marasović, *Kaštelanski kašteli*, 119.

[39] Marasović, "Kaštelanski kašteli," 339.

investigations carried out in 2017 and 2018[40]. Like in many other castles of Kaštela region Kaštilac had sea gates on the southern wall, as well as the drawbridge that connected the castle with the land[41]. The entrance to Kaštilac was further controlled by a three-storey gate tower to which the wooden drawbridge was attached, while the Abbess's House occupied part of the interior of the fortified complex[42].

Of the original defensive apparatus, the most articulated element is the entrance. The gate tower, at the centre of the northern wall, has an irregular rectangular plan of approximately 6.8 × 3.3 m and rises 15 m above sea level; it was originally enclosed on only three sides and was completed on its southern side in later phases. On its northern face, below the semicircular stone cornice, the 1769 cadastral drawing records the openings for raising the bridge, from which the severed chains still hung. The reopening of the western one in 1992 revealed, within the thickness of the wall, the seats of a wheel axle, consistent with a drum mechanism around which the chains were wound[43]. The timber drawbridge, pivoting on two stone corbels below the threshold, connected the tower to the masonry bridge, which stops 3.75 m short of its face[44].

Of the enclosure, by contrast, only traces of the crenellated parapet survive: a walled-up stretch on the eastern part of the northern wall and a single crenel, also walled up, on the eastern wall. The 1769 drawing shows the parapet still legible on the western stretch of the northern wall as well, which is now lost.

Later transformations can be read against this original arrangement, in which the houses built against the eastern, southern and western walls were single-storey, so that the wall-walk could run above them, while along the northern wall a strip approximately 4 m wide was kept free for defence. The raising of the houses above the walls erased this relationship between dwelling and defence. The tower followed the same course, and the material sign of its transformation into a civic tower is the central opening of the machicolation, walled up in 1853 to house the clock on the northern face[45]. In the final stage, the land reclamation of 1904–1905 on the northern front brought the level of the new square right up to the fortification, and doors were opened in the wall, some of them converted into shops, until the western stretch lost its defensive character altogether. The 1964–1965 restoration, which once again separated Kaštilac from the mainland, could not close these openings and secured access to them with a 4 m wide quay[46]. It is this stratification as a whole that forms the subject of the digital documentation.

Digital Survey and Data Processing

Following the methodology defined for the survey campaigns of the project, Kaštilac was documented through a fast-survey protocol combining range-based and image-based technologies, as already tested by the research group in other documentation projects[47]. This approach seeks a balance between metric reliability and

[40] These investigations established that the bedrock lies approximately three to five metres below the structure and about forty metres from the natural shoreline. Geotechnical investigations were carried out in 2017 by Institut IGH d.o.o.; the report was prepared by geotechnical engineer Ivica Samardžija and geologist Ivan Grbavac, but it remains unpublished. Marasović, *Kaštelanski kašteli*, 117.

[41] Marasović, *Kaštelanski kašteli*, 119, 143.

[42] Marasović, *Kaštelanski kašteli*, 154, 167, 175.

[43] Marasović, *Kaštelanski kašteli*, 154, 161, 165.

[44] Marasović, *Kaštelanski kašteli*, 147, 154.

[45] Marasović, *Kaštelanski kašteli*, 154 and 166.

[46] Marasović, *Kaštelanski kašteli*, 137–38.

[47] Sandro Parrinello and Francesca Picchio, "Digital Strategies to Enhance Cultural Heritage Routes: From Integrated Survey to Digital Twins of Different European Architectural Scenarios," *Drones* 7, no. 9 (2023): 576, 7–10.

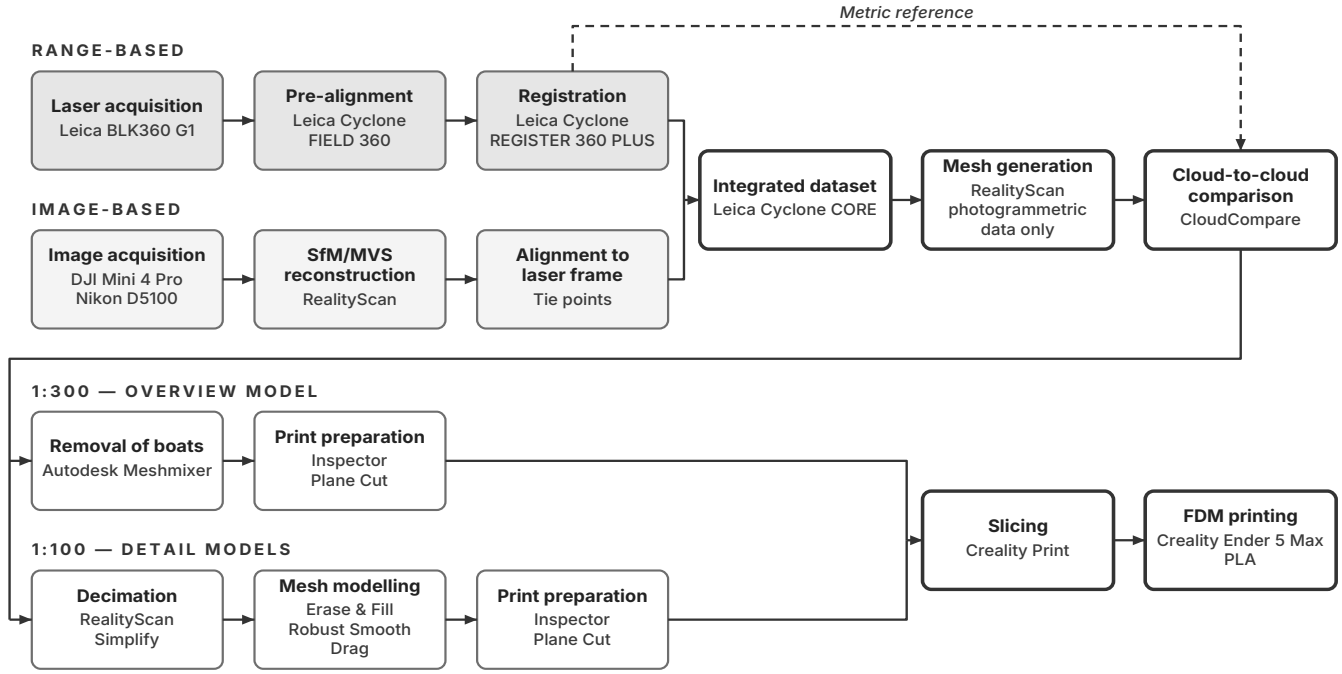


Fig. 5: Workflow from integrated laser scanning and photogrammetry to physical reproduction. The photogrammetric mesh is checked against the laser reference before two print-preparation paths are followed: an overview model at 1:300 and detail models at 1:100.

procedural efficiency, and makes the method replicable in different contexts. It also makes it possible to overcome the challenges posed by limited site accessibility[48], a condition that particularly affects Kaštilac.

Such campaigns require careful planning, since resolution and accuracy must be calibrated at the design stage according to the intended outputs[49]. This contribution therefore investigates the potential of a model derived from a fast survey to support the physical representation of a fortified building at different scales, and the level of reading that each scale allows of the building and of its history.

Kaštilac is surrounded by water on four sides. The eastern and southern fronts face directly onto the sea, while the northern front and part of the western one are accessible from the quay[50]. This condition limits the use of a terrestrial laser scanner, which requires a stable setup and captures only the surfaces visible from the scan position. The limited range of the scanner did not allow effective stations from the mainland, and the seaward fronts, not visible from the quay, remained outside the laser acquisition and were documented by the drone survey.

The laser survey comprised 56 scans, performed in

[48] Sandro Parrinello and Silvia La Placa, "La documentazione dei canali nella piana pavese: Esperienze di rilevamento con tecnologia SLAM per lo sviluppo di modelli informativi," *Dn. Building Information Modeling, Data & Semantics* 9 (2021): 34, 37.

[49] Alexandra Tsiachta et al., "Multi-Sensor Image and Range-Based Techniques for the Geometric Documentation and the Photorealistic 3D Modeling of Complex Architectural Monuments," *Sensors* 24, no. 9 (2024): 2671, 2.

[50] Marasović, *Kaštelanski kašteli*, 137–38.

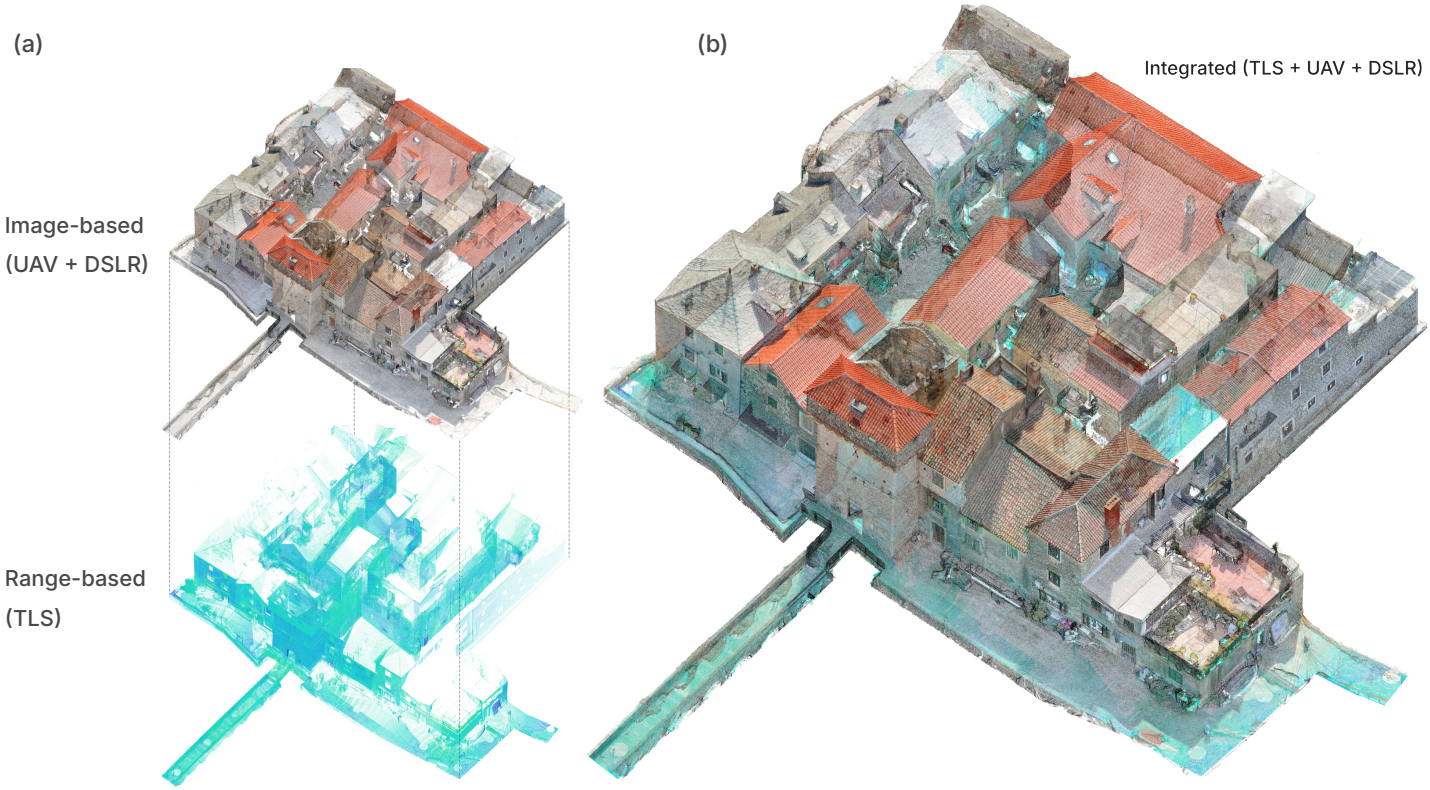


Fig. 6: Kaštilac. (a) Complementary coverage of image-based (UAV and DSLR) and terrestrial laser-scanning datasets; (b) the datasets integrated in a common reference system. The image-based survey records roofs and seaward fronts beyond the laser scanner's coverage.

false colour with a Leica BLK360 G1[51] in the rooms and passages inside the fortification and along the accessible fronts. The stations followed closed traverses with control diagonals, allowing the registration to be checked metrically. The image-based acquisition comprised 2,474 images: three flights with a DJI Mini 4 Pro drone, of 458, 386 and 339 images respectively, and a set of 1,291 ground-based images taken with a Nikon D5100 DSLR camera. The laser data provided the metric basis for the survey of the wall facings and their immediate surroundings. The photographic acquisitions captured the fronts not reachable from the quay, the roofs, and the colour and material appearance of the surfaces, following a principle of complementarity between techniques already tested in similar cases[52]. The workflow adopted, from acquisition to printing, is summarised in Fig. 1.

Processing began with the laser data. The scans, pre-aligned in the field in Leica Cyclone FIELD 360 v. 6.2, were registered in Leica Cyclone REGISTER 360 PLUS v. 2025.0.0 through visual alignment of the stations followed by cloud-to-cloud optimisation.

[51] The manufacturer's specifications state a range of 0.6 to 60 m, a ranging accuracy of 4 mm at 10 m, and a 3D point accuracy of 6 mm at 10 m and 8 mm at 20 m. Leica Geosystems, *Leica BLK360 Imaging Scanner: Product Specifications* (2020).

[52] Parrinello and Picchio, "Digital Strategies," 7–9.

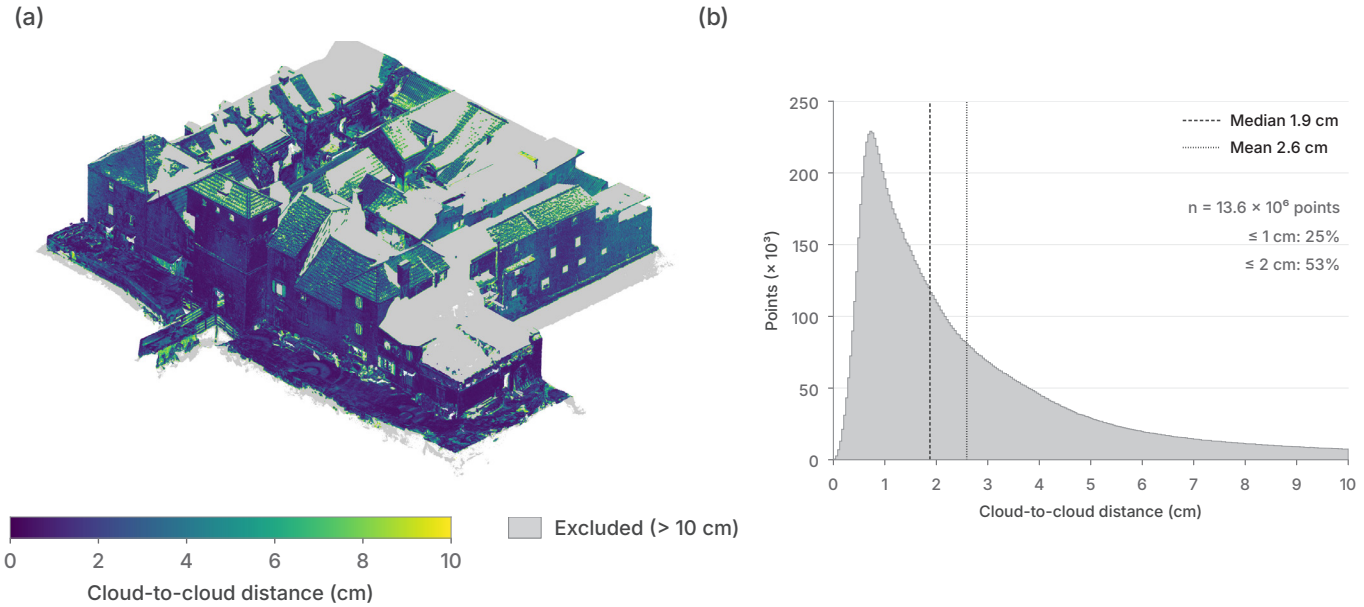


Fig. 7: Kaštilac. Cloud-to-cloud comparison of the photogrammetric and laser datasets: (a) spatial distribution of distances; (b) distance histogram for 13.6 million compared points. Distances above 10 cm are excluded; the median is 1.9 cm and the mean 2.6 cm. Values describe agreement in the overlapping areas, not an independent estimate of absolute accuracy.

The registration is based on 97 constraints between pairs of scans and yields a mean error of 1 mm on the active constraints, which measures the consistency between stations; the dispersion of individual points in the overlap areas is approximately 1.5 cm (RMS). The dataset was then managed in Leica Cyclone CORE v. 2023.1.0, where it was subsequently integrated with the photogrammetric data.

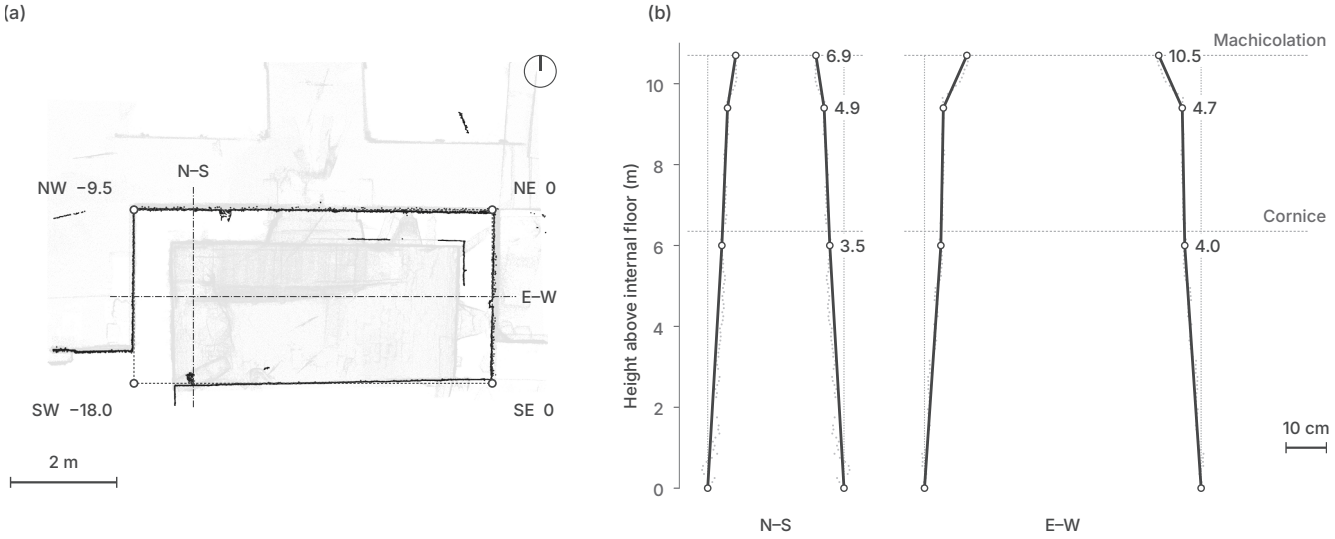
The photographic data were processed in RealityScan v. 2.2.1 following the standard SfM/MVS reconstruction pipeline. In the first stage, the software orients the images and generates a sparse point cloud; in the second, the cloud is densified through multi-view matching and triangulation in 3D space[53]. The photogrammetric reconstruction was first aligned in RealityScan using 20 control points identified on morphological features recognisable in both point clouds. The resulting dense cloud, exported in E57 format, was then registered onto the scans in Cyclone CORE through a cloud-to-cloud constraint, with a root mean square deviation of 3.0 cm over the overlap area, forming the integrated laser and photogrammetric dataset of the fortified complex (Fig. 2)[54].

In integrated survey practice, the polygonal model is commonly generated from a dataset of this kind, following a cloud-to-mesh approach that combines the geometric accuracy of the laser data with the radiometric quality of the photographic data[55]. In the present case, this procedure was not adopted. The laser data,

[53] Federica Giacomini, "Tecniche image-based di acquisizione 3D e modelli di condivisione dei dati generati nell'ambito del Patrimonio Culturale" (PhD diss., Alma Mater Studiorum – Università di Bologna, 2025), 23.

[54] Parrinello and La Placa, "La documentazione dei canali," 38–40.

[55] Tsiachta et al., "Multi-Sensor Image," 25.



Section at about 6.6 m above the internal floor; lower parts in grey. Cornice level relative to the eastern corners (cm).

Three-segment schematic; circles: joints; grey dots: measured values. Reduction per side relative to the base (cm); deviations exaggerated ×10.

Fig. 5: Survey-derived measurements of the Kaštilac entrance tower, used for comparison with published data: (a) differences in cornice levels; (b) wall tapering along the N–S and E–W axes, with horizontal deviations exaggerated tenfold.

although metrically reliable, showed widespread noise on the surveyed surfaces, consistent with the deviation recorded in the overlap areas between scans. When imported into RealityScan together with the images, the scans produced surfaces with evident reconstruction anomalies. The mesh was therefore generated only from the photogrammetric data, while the laser data remained the reference for metric verification. The resulting mesh adheres less closely to the actual geometry than one generated with the contribution of the laser data would[56].

This deviation was quantified through a cloud-to-cloud comparison between the photogrammetric and laser clouds, the latter taken as reference, carried out in CloudCompare v. 2.13.2 on clouds subsampled to 1 cm and limited to points within 10 cm of each other. Of the photogrammetric points, 39% are excluded from the comparison because they have no correspondence in the laser data; visual inspection confirmed that they correspond to the surfaces the scanner could not reach, in particular the seaward fronts and the roofs (Fig. 2), and to non-architectural elements present in only one of the two datasets. On the remaining 61%, the mean deviation is 2.6 cm, with a standard deviation of 2.1 cm. The distribution is skewed, with 25% of the points within 1 cm, 53% within 2 cm and a median of 1.9 cm (Fig. 3). These values also include the noise of the reference data, which is of the same order of magnitude (1.5 cm RMS), and the residual misalignment between the two datasets; they therefore tend to overestimate the actual deviation of the photogrammetric surface.

[56] Hangjun Fu, "Reverse modeling per la stampa 3D di complessi monumentali," in *Transizioni. Atti del 44° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione*, ed. Mirco Cannella, Alessia Garozzo, and Sara Morena (Milan: FrancoAngeli, 2023), 1314.

From Raw Model to 3D Printing

Within the project, 3D printing was not conceived as a final replica of the survey, but as a further means of reading it. A physical model offers haptic, tactile access to the building. It can be handled and observed from any point of view and makes its geometry intelligible to a non-specialist public[57]. The exhibition for which the prints were produced required them to work at two levels: overview models, relating the surveyed sites to their territory and to one another, and detail models, showing how much of each building becomes legible as the scale increases. The choice of scale thus becomes a choice of what the print is meant to show, which is why the discussion that follows draws on other case studies of the project as well as on Kaštilac.

The mesh of Kaštilac generated in RealityScan consists of approximately 181.4 million triangles and 90.8 million vertices. Although highly detailed, it remains a raw product. It contains gaps in areas with lower photographic coverage, non-architectural elements captured together with the building (boats, street furniture, vegetation), and incorrectly reconstructed geometries at the transitions between photogrammetric blocks. These are recurrent defects in reverse modelling processes applied to monumental complexes, which also require the interpretation of missing surfaces[58] and are addressed in the modelling phase.

The modelling pipeline developed within the project is described through the Cippico Tower in Kaštel Novi and Kaštel Cippico in Kaštel Stari. The first step is the decimation of their meshes in RealityScan using the *Simplify* tool. To keep the modelling process fluid and reduce processing times, the reduction was set as a ratio of the original mesh: one half for lighter meshes and one quarter for heavier ones. For the Cippico Tower, this meant a reduction from 40 to 20 million triangles; for Kaštel Cippico, from 185.7 to 46.4 million. The decimated meshes are then processed in Autodesk Meshmixer v. 3.5 through three operations (Fig. 4)[59]:

Removal of non-architectural elements, isolated by direct selection on the mesh and deleted.

Reconstruction of gaps by interpolating the missing surface from the curvature of the surrounding boundary (*Erase & Fill*), limited to cases where the result is consistent with the course of the adjacent masonry.

Smoothing of surfaces through localised interventions (*Robust Smooth* and *Drag* brushes of the *Sculpt* tool), which correct residual irregularities without altering the overall geometry.

The aim is a balance between the geometric control needed to make the mesh printable and the preservation of the material character of the survey data. The result is a controlled reworking of the photogrammetric data, distinct from an idealised reconstruction of the building.

Print preparation follows, again in Meshmixer, and is governed by the machine used: a Creality Ender 5 Max fused deposition modelling (FDM) printer, using PLA, with a 400 × 400 mm build plate. The size of the build plate sets the maximum dimension of each part and, for a given scale, determines the number of parts into which the mesh must be divided[60]. Preparation comprises two operations:

- Topology check and repair. The *Inspector* tool detects and repairs non-manifold geometries and residual discontinuities, since a closed surface is a prerequisite for any additive manufacturing technology.
- Base definition and sectioning. The *Plane Cut* tool is used

[57] Francesca Picchio and Giulia Porcheddu, "3D Database as an Element of the Knowledge Process of City Walls," in *Architectures along James I Itinerary in the Valencian Province*, ed. Sandro Parrinello and Francesca Picchio (Florence: Firenze University Press, 2026), 133.

[58] Fu, "Reverse modeling," 1311, 1318.

[59] Nemeh Rihani, "Interactive Immersive Experience: Digital Technologies for Reconstruction and Experiencing Temple of Bel Using Crowdsourced Images and 3D Photogrammetric Processes," *International Journal of Architectural Computing* 21, no. 4 (2023): 742; see also Parrinello and Picchio, "Digital Strategies," 14.

[60] Diego Francisco García-Molina et al., "Comprehensive Design of the 3D Printing Process for Architectural Models. A Case Study: The Medieval Walled Enclosure of Priego de Córdoba (E1:200)," *Multimedia Tools and Applications* 84 (2025): 4892; Fu, "Reverse modeling," 1316–17.

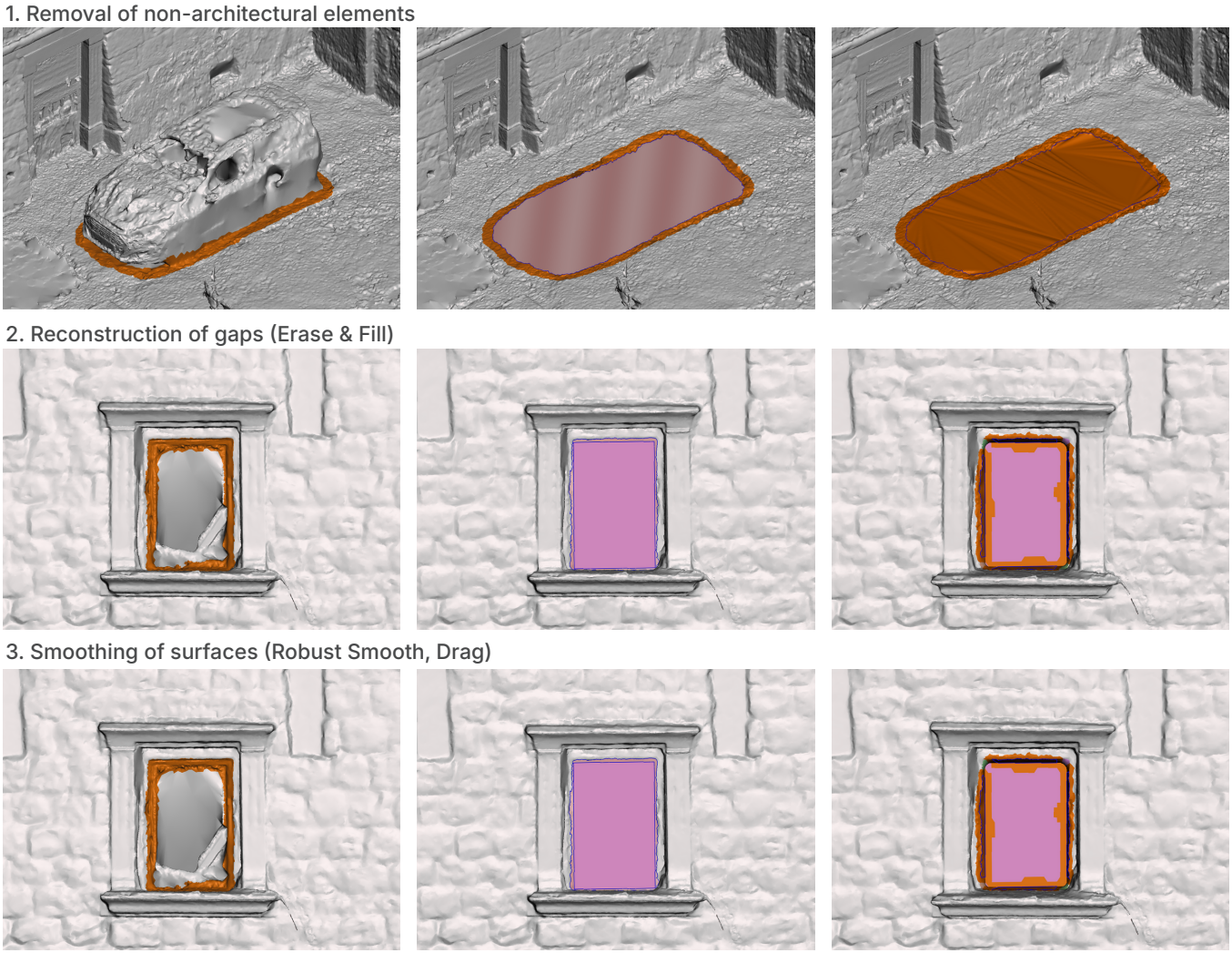


Fig. 8: Examples of local mesh preparation for 3D printing: removal of non-architectural elements, reconstruction of gaps with Erase & Fill, and local smoothing with Robust Smooth and Drag. The interventions adapt the survey-derived surface to physical reproduction.

first of all to define the base of each mesh, producing a flat contact surface on the build plate. When the dimensions of the scaled mesh exceed those of the build plate, the same tool allows it to be divided into separately printable parts, with the cutting planes placed in areas of least surface detail to limit the visibility of joints in the reassembled print. In the two cases described here, which fitted within the build plate, the base cut was sufficient.

Finally, the meshes are processed in the Creality Print v. 7.0 slicer with a profile common to the whole project: a layer height of 0.12 mm, an outer shell of two extrusion lines, 15% grid infill, and supports added only where necessary.

Results and Discussion

The two levels required by the exhibition thus translate into two printing scales, each corresponding to the degree of preparation the mesh received. The overview model of Kaštilac was printed at 1:300 in a single piece, in about 4 hours, and measures approximately 183 × 133 × 50 mm (Fig. 5a). At these dimensions, surface irregularities fall below the printing resolution, and the mesh required only the removal of the boats captured around it and print preparation, without the gap-filling and smoothing operations of the pipeline. The detail models of the Cippico Tower and Kaštel Cippico were printed at 1:100, after the full pipeline (Fig. 5b).

The comparison between the two scales shows that it is the printing scale that determines how much of the surveyed detail reaches the print. The reference is the smallest significant architectural element, which once scaled down should not fall below the visual perception threshold of approximately 0.2 mm[61]. This limit is compounded by that of the machine. Vertically, resolution is given by the layer height of 0.12 mm, already below the threshold; in plan, however, the printer cannot reproduce elements thinner than the extrusion line, which is 0.42 mm wide. Transferred to the actual size of the buildings, this width corresponds to about 12.6 cm at 1:300 and 4.2 cm at 1:100. In the first case, therefore, it is the printer rather than the eye that filters out detail, and with it the defects of the mesh; in the second, a much larger share of both reaches the print, which is why the Cippico meshes required the full pipeline.

In the 1:300 print of Kaštilac, the median deviation measured between the two datasets corresponds to 0.06 mm and the mean deviation to less than 0.1 mm, values well below the perception threshold. If Kaštilac were printed at 1:100, the same deviation would instead correspond to 0.19 mm, at the limit of the threshold. The print, measuring approximately 550 × 400 mm in plan, would exceed the build plate, and the raw mesh would no longer be suitable for direct printing, since gaps, non-architectural elements and surface irregularities would become legible in the print, making the full pipeline necessary, from the decimation of the mesh to its division into parts. The problem thus shifts from the precision of the data to the manageability of the mesh. Simplification, a recurrent practice in handling large photogrammetric models[62], does not, however, necessarily entail a loss, since the degree of accuracy of a model is a relative criterion, to be established according to its intended use, and detail beyond what the print can render entails longer processing times and data overload without any real gain in information.

These results must be read within certain limits. The reliability of the photogrammetric mesh is verified only on the portions surveyed by both techniques, whereas the seaward fronts and the roofs, captured by photogrammetry alone, lack independent metric verification. For Kaštilac, moreover, the assessment at a larger scale remains a projection, since it has so far been printed only at the smaller scale.

Conclusions and Future Developments

Read across scales, the prints answer different questions. The print of Kaštilac conveys the relationship between the artificial islet, the enclosure and the tower, the defensive logic of water discussed in the historical section, and allows Kaštilac to be compared with the other fortifications of the area. The traces of stratification, mostly walled up or flush with the wall, differ from the masonry only by reliefs of a few centimetres and by changes of material. They fall below what this print can render, but remain within the reliability of the photogrammetric mesh, whose median deviation of 1.9 cm from the laser data is compatible with elements in the order of decimetres, such as the openings for the drawbridge chains, the walled-up crenels of the parapet

[61] García-Molina et al., "Comprehensive Design," 4889.

[62] Rihani, "Interactive Immersive Experience," 753; Parrinello and Picchio, "Digital Strategies," 12–13.

or the central opening of the machicolation, and call for a larger scale.

The survey also makes it possible to test on the point cloud some of the published data. The external dimensions of the enclosure, 35.4 × 37.2 m, are confirmed, as are the plan dimensions of the entrance tower, approximately 6.8 × 3.3 m, measured 1.4 m above the internal floor level. The geometric features and deformations described in the literature, well above the median deviation of the mesh, are also legible. Assuming that the tower cornice was originally laid level, its corners record the differential settlement of the tower. Relative to the eastern corners, which lie at the same level, the north-western corner is approximately 9.5 cm lower and the south-western one approximately 18 cm lower, so that the settlement increases from east to west and is greatest at the south-western corner, consistent with the 20 cm reported on the basis of the 2017 architectural survey (Fig. 6a). The tapering of the tower, described in the literature as a feature of the walls distinct from the tilt acquired over time, can also be measured (Fig. 6b). Between the internal floor level and the machicolation, over a height of approximately 10.7 m, the reduction ranges from about 7 to 10 cm per side, depending on the axis and on the position along the faces, compared with the 7 cm reported[63]. It does not, however, proceed uniformly: by about 6 m above the internal floor the faces have already drawn in by 3.5–4 cm per side; between 6 and 9.4 m they rise almost vertically; just below the machicolation they step back by a further 2–6 cm. The change in inclination thus lies just below the tower cornice rather than coinciding with it, unlike other towers in the area, where the same moulding marks the transition from the vertical wall to the battered base. On the seaward fronts, documented by photogrammetry alone, the mesh shows the houses raised above the level of the enclosure, the windows opened after the loss of its defensive function and the trace of a walled-up sea gate on the southern wall, consistent with the transformations described in the historical section.

Physically representing these traces would require printing Kaštilac at least at 1:100, at which the detail the print can render must be preserved while the mesh is reduced to keep modelling operations fluid. The limit that emerges therefore lies not in the fast survey, which produced more data than the modelling workflow can efficiently handle, but in the passage from the digital to the physical model. Making explicit the choices of decimation, reconstruction and print preparation that govern this passage is what turns the print into a tool of knowledge rather than a mere replica.

Further work will extend this workflow beyond the printed object. A larger-scale print of Kaštilac, produced through the full pipeline, could become the physical support of an augmented reality interface. A recent application has shown that a 3D-printed scale model offers a stable anchor for digital content, and that users favour larger models[64]; in that case, however, the scale model was designed from drawings, whereas a print derived from survey data would make the overlaid information metrically consistent with the physical object. Framed by a mobile device, the print would be overlaid with the photogrammetric texture, restoring the colour and material appearance that the PLA print does not convey, and with metric and stratigraphic information drawn from the survey and from the reading of the building, such as the settlement of the tower, the walled-up openings and the construction phases. The traces of stratification that fall below the resolution of the printer would thus return to the print as a digital layer. The printed model would in turn become the premise for a new digitisation, closing a workflow that moves from survey data through modelling and printing back to the digital domain.

[63] Marasović, *Kaštelanski kašteli*, 119-161.

[64] Sophie Galani and Spyros Vosinakis, "An Augmented Reality Approach for Communicating Intangible and Architectural Heritage through Digital

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KAŠTEL CIPPICO AND KAŠTEL STAFILEO: FROM POINT CLOUD MACHINE LEARNING TO HBIM OF HISTORICAL STRATIFICATIONS

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University of Florence

The landscape of Dalmatia between relationships, signs, and memory

The landscape of central Dalmatia defines its identity in the cultural and evocative dimension of the coast. Like any space between the mainland and the sea, this territory expresses a vocation of connection and limit, the result of the overlapping historical borders between the Kingdom of Hungary, the Republic of Venice, the Ottoman Empire, and the Habsburg Empire[1].

This succession of dominations shaped the physical space of the coastal villages, leaving behind a cultural heritage structured on the dialogue between defense and settlement. In this borderland space - marked by conflicts and geopolitical reconfigurations - digital documentation serves as the tool to investigate, from a historical-critical perspective, the morphological evolution of the quadrangular-plan fortified settlements located along the coast between Zara, Sebenico, Traù, and Spalato.

Within this system, the complexes of Kaštel Cippico (*Kaštel Stari*) and Kaštel Stafileo (*Kaštel Štafilić*) represent two case studies for analyzing the temporal stratifications that have constructed the current image of these locations.

In this area, which assumed a strategic role for the control of the eastern Adriatic between the 15th and 17th centuries, a dense network of fortified nuclei emerged, developing in response to the pressing defensive needs of Ottoman expansion[2]. These structures represented the only form of protection for rural communities dedicated to cultivating the coastal plains, falling under the jurisdiction of the main urban centers.

Although subsequent processes of urban expansion have partially altered the morphological legibility of these historical layouts, the traces of their original configuration remain imprinted in the materials and persistences visible today. Structures such as Castel Cippico or Castel Stafileo preserve the memory of their connection with the Dalmatian patriciate and the Venetian administration, similarly to what can be observed in the fabric of neighboring centers like Seghetto (Seget) or in the settlement of Vragnizza (Vranjic), integrated into the coastal defensive and productive systems[3]. Through experimentation on these case studies, the objective is to define a structured

[1] S. Parrinello, "Metodi e risultati dell'analisi della ricerca per la documentazione digitale a Sebenico / Digital Documentation of Šibenik: Methods and Results," in *3D SEBENICO: 3D Survey of Built Venetian Historic Fortresses*, ed. S. Parrinello et al. (Pavia University Press, 2024), 55–65.

[2] J. Pavić, I. Glavaš, and A. Nakić, "Rakitnica; Dazlina and Velim—the Remains of the One-Time Defence of the Western Area of Šibenik District," *Radovi Zavoda za povijesne znanosti HAZU u Zadru,* no. 62 (2020): 113–38.

[3] K. Marasović, "Nastanak i razvitak kaštelanskih utvrdenih naselja," *Histria antiqua* (2003).

methodological framework aimed at the knowledge, digitization, and valorization of the fortified heritage of central Dalmatia. Moving within the guidelines of the research project, the study intends to analyze material traces through the use of integrated digital technologies, useful for structuring relational databases and scenarios for narration and representation. The analyses flow into an archive capable of explicating the morphometric, technological, and constructive characteristics of the structures, laying the foundation for future protection and conservation interventions. The construction of digital models representative of this historical heritage requires identifying strategies that go beyond the geometric representation of the current state. The experimentation in Kaštel Cippico and Stafileo for architectural documentation aims to demonstrate how morphological and syntactic peculiarities connect this specific typology of structures and can guide automated procedures for the interpretation and classification of geometric data.

The testing of a protocol that combines integrated three-dimensional survey techniques (laser scanner and photogrammetry) with automatic semantic segmentation methods - developed using Machine Learning algorithms in a Python environment - finds an ideal testing ground in these case studies. The algorithm is tested to evaluate its ability to recognize and isolate architectural components, encoded based on the constructive characteristics and formal analogies typical of their geographical context.

The transposition of this heritage into HBIM (Heritage Building Information Modeling) models interconnected with searchable databases allows making knowledge accessible and facilitating its dissemination[4].

The typology of Kaštela systems in Central Dalmatia

To understand the structure of the digital model, it is essential to clarify the typological matrix of the object of investigation. This architectural structure developed between the fifteenth and sixteenth centuries, a period in which the Republic of Venice had to reorganize its defenses to stem the pressure of the Ottoman Empire in the Balkan hinterland. Unlike the large urban bastioned fortresses designed by military engineers of the Serenissima for the main coastal centers, the castles were built through the initiative of patrician families and landowners. They respond to a dual need, guaranteeing the safety of rural communities and protecting the productive and agricultural activities of the plain[5].

From a morphological and functional point of view, the palace is defined as a compact building organism, an element of military garrison, and a place of representation for an extra-urban noble residence. The Dalmatian patrician *kaštel* is not a castle of feudal origin, but a fortified palace: a typology that combines the representational requirements of the Renaissance residence with coastal defense devices[6]. The layout consists of a quadrangular enclosure closed by walls, structured around a central porticoed courtyard, with the main residential body facing the sea to the south and a quadrangular tower positioned to guard the main access on the north front, toward the land[7].

Founded in 1481 by Coriolano Cippico - humanist, trireme commander under Captain General Pietro Mocenigo, and a prominent figure of the Trogir nobility - the castle of Kaštel Stari was built on emerging rocks

[4] S. Brusaporci, P. Maiezza, and A. Tata, "A Framework for Architectural Heritage HBIM Semantization and Development," *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* 42 (2018): 179–84.

[5] S. Parrinello et al., *3D SEBENICO: 3D Survey of Built Venetian Historic Fortresses,* Prospettive multiple: Studi di ingegneria, architettura e arte (2024), 1–176.

[6] D. Bilić, "I protagonisti dell'edilizia militare in Dalmazia nei secoli XVII e XVIII," in *Architettura militare di Venezia in terraferma e in Adriatico fra XVI e XVII secolo: Atti del convegno internazionale di studi, Palmanova, Teatro Gustavo Modena, 8–10 novembre 2013*, Biblioteca dell'Archivum Romanicum, serie I, 436 (2014), 359–79.

[7] D. F. Karaman, "Castel Stafileo," *Bullettino di archeologia e storia dalmata* XIV (1889): 138–43.



Fig. 1. The case studies and their current architectural layout.



Fig. 2. The typological layout of the kaštel-palaces of Kaštel Cippico and Kaštel Stafileo, documented through drone acquisitions

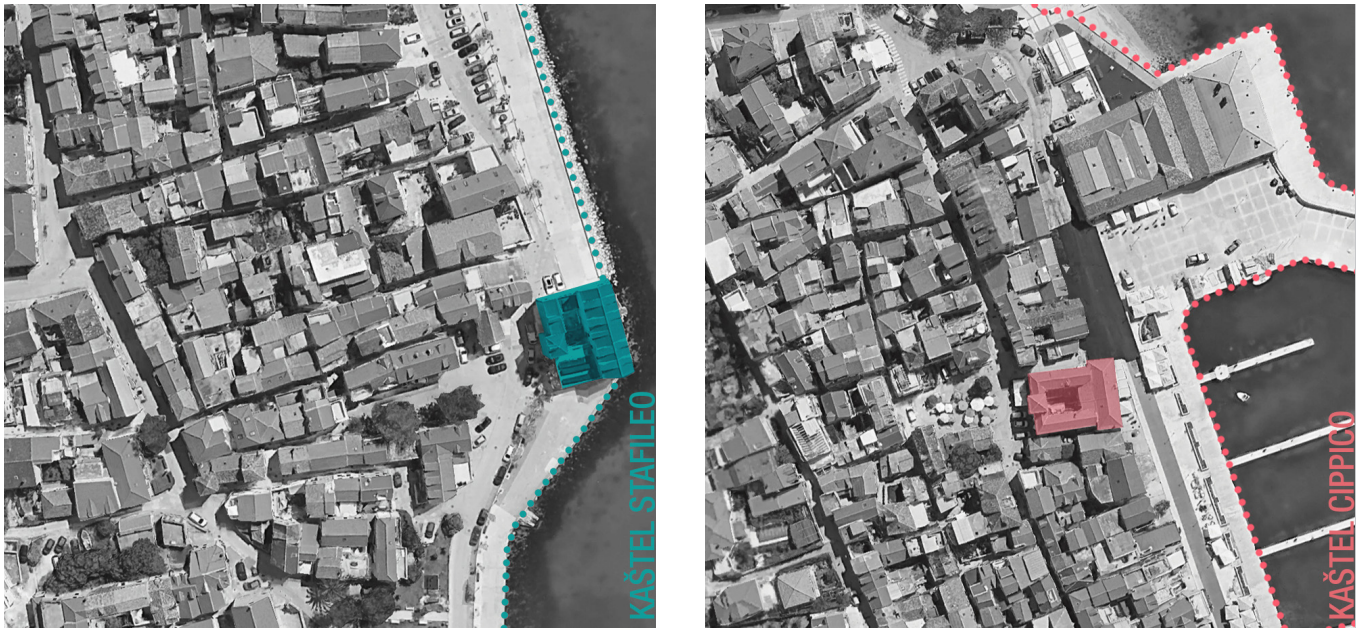


Fig. 3: Location of Kaštel Cippico and Kaštel Stafileo within the urban fabric.

thirty meters from the original coastline, connected to the mainland via a wooden bridge[8]. In this second phase, the internal courtyard was enriched with a two-level Renaissance loggia with twelve columns, inspired by the solutions adopted by Coriolano in the family palace in Trogir[9].

Kaštel Stafileo was built shortly after, in 1508, on the initiative of the nobleman Stjepan Stafileo. Compared to Cippico, from which it inherits and improves the spatial organization, Stafileo has an even more direct connection with the water. The building had two entrances: the land gate to the north, consisting of a drawbridge, and the sea gate to the south, which was later walled up.

The internal articulation of the residential volumes to the south corresponds to a rigid and repetitive typological pattern. The *piano nobile* develops around a central reception hall flanked by two side rooms, each equipped with a built-in fireplace[10].

The side facades and defensive wings delimiting the courtyard present an even more rigid configuration in the vertical development of the floors. On the first floor, originally used as storage and servants' quarters with small windows and parapets over 1.90 meters above the floor level, the outer perimeter walls appear as blind walls. Moving up to the second floor, the wings transform into a covered walkway, open to the outside through a sequence of loopholes and defensive stone-

[8] D. F. Karaman, "Coriolano Cippico di Traù," *Annuario dalmatico* I (1884): 169–82.

[9] K. Marasović, "Studija prostornog razvoja Kaštel Staroga uz posebnu analizu izgradnje kaštela Cippico" (doctoral dissertation, Arhitektonski fakultet, 1996).

[10] K. Marasović, *Kaštelanski kašteli* (Muzej grada Kaštela; Fakultet građevinarstva, arhitekture i geodezije u Splitu, 2025).



Fig. 4: Details of the traces of historical transformations preserved within the masonry of the kaštel-palaces.

framed windows. The crowning of the structure was defined by battlements on wooden beams integrated with bartizans, overhanging machicolations supported by stone corbels with lower loopholes for vertical fire[11]. At the end of the 17th century, with the easing of the Ottoman threat, defensive functions gave way to new residential needs. Both complexes underwent profound residential transformations that altered their volumes, while leaving visible the material traces of the original stratigraphy. At Kaštel Cippico, the courtyard portico was walled up, the tower functionally separated to create independent housing, and the corbels of the northern bartizan reused as the walking surface for a new balcony. Concurrently, at Kaštel Stafileo, the

[11] K. Marasović, "Kaštelanski kašteli" (doctoral dissertation, Arhitektonski fakultet, 2002).

transition to residential use entailed the addition of an extra floor, the construction of an access staircase leaning against the north facade, and, in recent times, the replacement of the hip roof with flat roofs and staggered terraces[12]. This dense stratification makes it essential to construct a knowledge model capable of interpreting the historical phases, attributing to each geometric element its correct chronological horizon.

Methodologies for the integration of morphometric survey

The acquisition phase, following the preliminary study of the artifact, represents the first moment of direct contact with the object[13]. To overcome these constraints, a fast survey methodology was adopted, a protocol capable of optimizing resources to render the spatiality that characterizes the architecture. The integrated survey strategy was structured around the use of laser scanner systems based own SLAM technology, carried out outside the complexes and executing acquisitions from stations capable of describing the various parts of the structure. The overlap of common points between contiguous scans facilitated rigid rototranslation procedures, necessary to register the data into a single global coordinate system; a database was constructed capable of linking the enclosed space of the porticoed courtyards and the street facades into a single point cloud. The laser surveys exclusively covered the portions and volumes accessible from the outside, a condition sufficient to achieve the cognitive and representational objectives of the project. In parallel with this logic, digital acquisition followed an organizational structure defined by the intrinsic characteristics of the site. The integration of laser scanner sensors with remotely piloted systems for acquiring the roof areas and elevated portions of the building made it possible to capture images intended to structure a logical order of knowledge for each site. This integrated approach allowed for the definition of drone photography methodologies, laying the groundwork for a protocol adaptable to the various *kaštel*-palaces along the Dalmatian coast.

The data collected from the ground using laser scanning equipment were completed through integration with aerial drone photogrammetry techniques, following a process based on the specificities of each site. The impossibility of accessing certain facades due to natural barriers such as the sea, or the need to document elevated elements, made the use of remotely piloted systems indispensable, shifting the lens of the instrument above roof level. Within the fabric of urban alleys and facing complex facade layouts, operational execution times were minimized compared to traditional frame acquisition through the introduction of videogrammetric procedures. Video footage recorded along the facades and roofs made it possible to capture the geometric and chromatic properties of the building's vertical elevation, anticipating light changes caused by the solar cycle throughout the day. This measure ensured the chromatic uniformity of the frames, a favorable condition for frame alignment processes within Structure from Motion software[14].

During processing, frame extraction within photo-modeling software made it possible to document construction details at a level of definition suited to the representational objectives. The photogrammetric point cloud, originally lacking real-world dimensional values, was scaled and constrained to the rigid framework defined by the laser acquisitions. The construction of a model with a single reference system (global UCS) - the product of the integrated survey, comprising points with spatial coordinates, chromatic values, and intensity values -

[12] C. Fiskovic, "Dodiri mletačkih i dalmatinskih kipara i graditelja do XV stoljeća" (1971).

[13] S. Parrinello and R. De Marco, "Digital Surveying and 3D Modelling Structural Shape Pipelines for Instability Monitoring in Historical Buildings: A Strategy of Versatile Mesh Models for Ruined and Endangered Heritage," *Acta IMEKO* 10, no. 1 (2021): 84–97.

[14] A. Pettineo and G. Pancani, "Fast-Survey Techniques for Digital Mapping and Understanding the Ksar of Ait Ben Haddou," in *Emerging Research in Materials, Environment, and Civil Infrastructure*, vol. 58 (Materials Research Forum, 2026), 123–29.

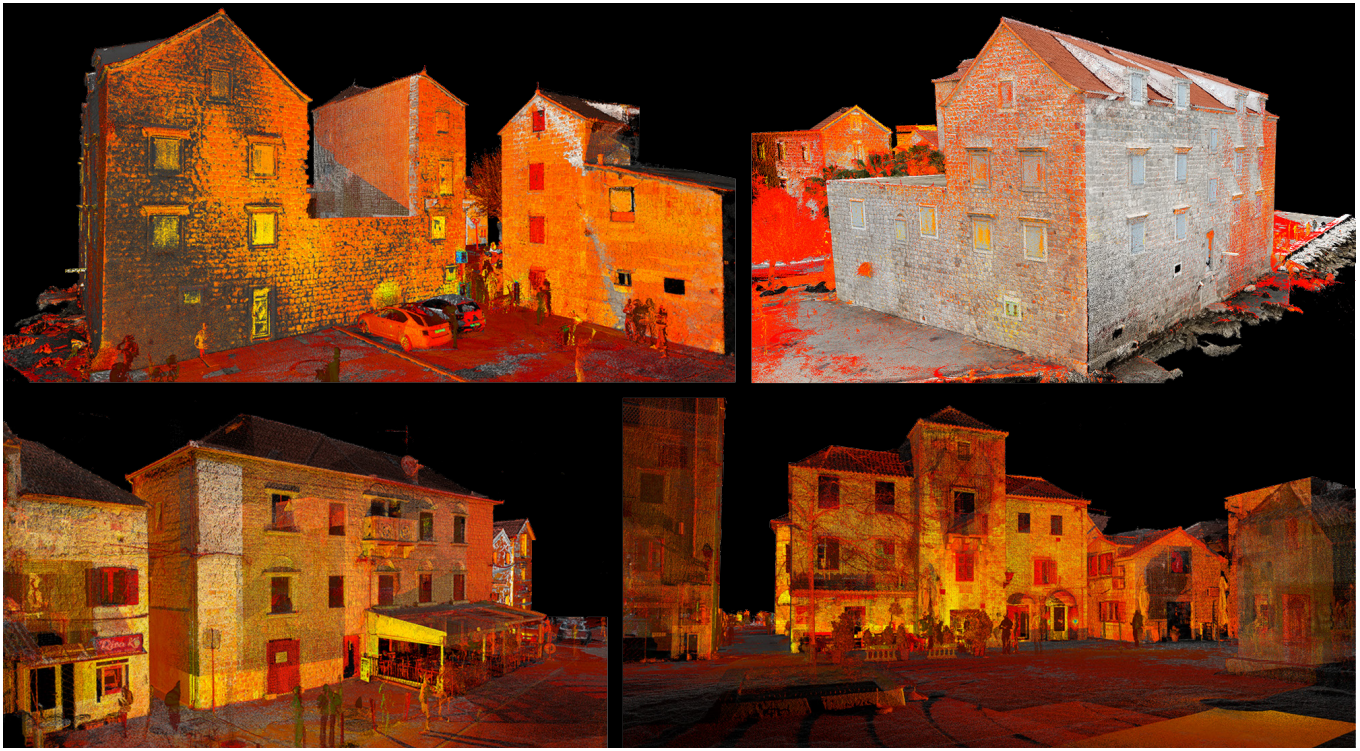


Fig. 4: Point cloud with intensity values, highlighting areas characterized by reduced point density in the elevation portions of the structure.

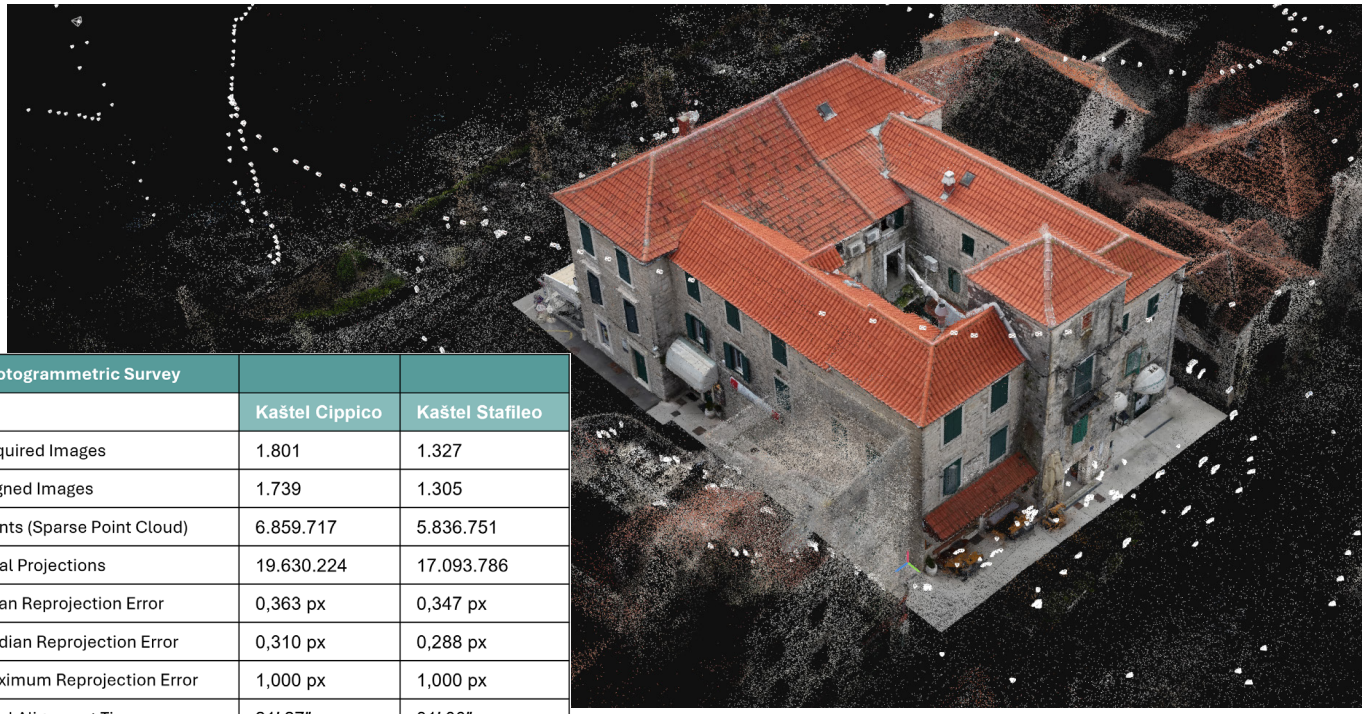
structured the foundation for setting up the segmentation and interpretation process. The role of these databases is to serve as an archive in which to record the current image of the Venetian fortresses, digitally translating the complexes and their geometric and material peculiarities. This breakdown anticipates the goal of advancing the understanding of the artifact, putting into practice the ambition of transposing the real object into digital space: a metric archive that serves as an infrastructure for interpretation through Machine Learning algorithms and for the subsequent decomposition of the HBIM model into chronological phases.

An algorithm for interpreting spatial data applied to fortified palaces

The application of Machine Learning to survey data finds significance in its ability to organize the complexity of spatial and geometric information, translating it into structured subsets and specific categories designed to guide the interpretive process of modeling[15].
By their very nature, point cloud data are unstructured, unordered, and often noisy. The lack of order makes the application of traditional Deep Learning[16] models complex, necessitating the development of Machine

[15] V. Croce et al., "From the Semantic Point Cloud to Heritage-Building Information Modeling: A Semiautomatic Approach Exploiting Machine Learning," *Remote Sensing* 13, no. 3 (2021): 461.

[16] The terms Machine Learning (ML) and Deep Learning (DL) refer to algorithms applied to point clouds to automate the classification of raw



Photogrammetric Survey		
	Kaštel Cippico	Kaštel Stafileo
Acquired Images	1.801	1.327
Aligned Images	1.739	1.305
Points (Sparse Point Cloud)	6.859.717	5.836.751
Total Projections	19.630.224	17.093.786
Mean Reprojection Error	0,363 px	0,347 px
Median Reprojection Error	0,310 px	0,288 px
Maximum Reprojection Error	1,000 px	1,000 px
Total Alignment Time	21′ 27″	31′ 00″

Fig. 5: Photogrammetric Processing Workflow and Comparison of Datasets from the Two Case Studies.

Learning algorithms capable of analyzing, classifying, and interpreting three-dimensional sets composed of millions of points in space[17].

The constructive regularity characterizing Dalmatian fortified palaces - structures defined by recurring morphological elements encoded according to stylistic classes from the same historical period - provides a foundation for testing the automatic segmentation of point clouds. Typically, point cloud classification relies on pre-trained models managed through external libraries such as TensorFlow, PyTorch, or scikit-learn. Although effective, these solutions require high computational resources; to overcome this limitation, the need arises to develop an algorithm based on the formal and decorative features that recur in this specific building typology. By developing a script in a Dynamo environment that exclusively uses Python's standard library, without any dependencies on external packages or pre-existing models, the feasibility of this approach relies entirely on the typological logic of Dalmatian fortified

data, capable of converting spatial coordinates into typologically recognized informative elements. The difference lies in the treatment of geometric features: Machine Learning requires the manual extraction of local descriptors (such as normals and curvature), making it computationally lightweight but less flexible in the presence of inhomogeneous geometries; Deep Learning, on the other hand, learns spatial relationships directly from the point cloud, guaranteeing high accuracy in complex contexts at the expense of higher requirements for labeled data and computing power.

[17] Y. Guo et al., "Deep Learning for 3D Point Clouds: A Survey" (IEEE, 2020).



Fig. 6: Visualization of the photogrammetric point cloud, highlighting the elevated portions of the structure, including the roofs.

architecture. Since the patrician *kaštel* is composed of a finite, redundant, and repetitive repertoire of recurring architectural classes, it is possible to translate the rules of architectural syntax into geometric-spatial constraints directly executable by code. The logic of the code is based on the Nearest Centroid principle, integrated with a spatial optimization filter to suppress classification noise. The workflow begins with Kaštel Stafileo, taken as a training model, whose points were manually grouped into fourteen typological subsets. The selection includes components - such as ground, masonry, window frames, pitched and flat roofs, vertical connections, openings, and their relative moldings - encoded in separate text files to instruct the system on the geometric and material variations specific to each constructive element.

In the extraction phase, each point of the cloud is translated into a six-dimensional descriptive vector combining spatial position with chromaticity parameters. To these elements are added the altimetric elevation and the verticality index derived from the point normal, a useful indicator for distinguishing wall partitions from sloped roof surfaces or floor planes. To prevent heterogeneous quantities from distorting data alignment, the vectors are standardized using Z-score normalization, preventing spatial coordinates from overriding chromatic properties. Within this normalization, a weighting system attenuates the impact of the Z-coordinate, preventing continuous masonry from being fragmented into distinct classes simply due to its vertical extent.

Once the training data are normalized, the script calculates the mean of the vectors for each typological category, generating fourteen ideal centroids that

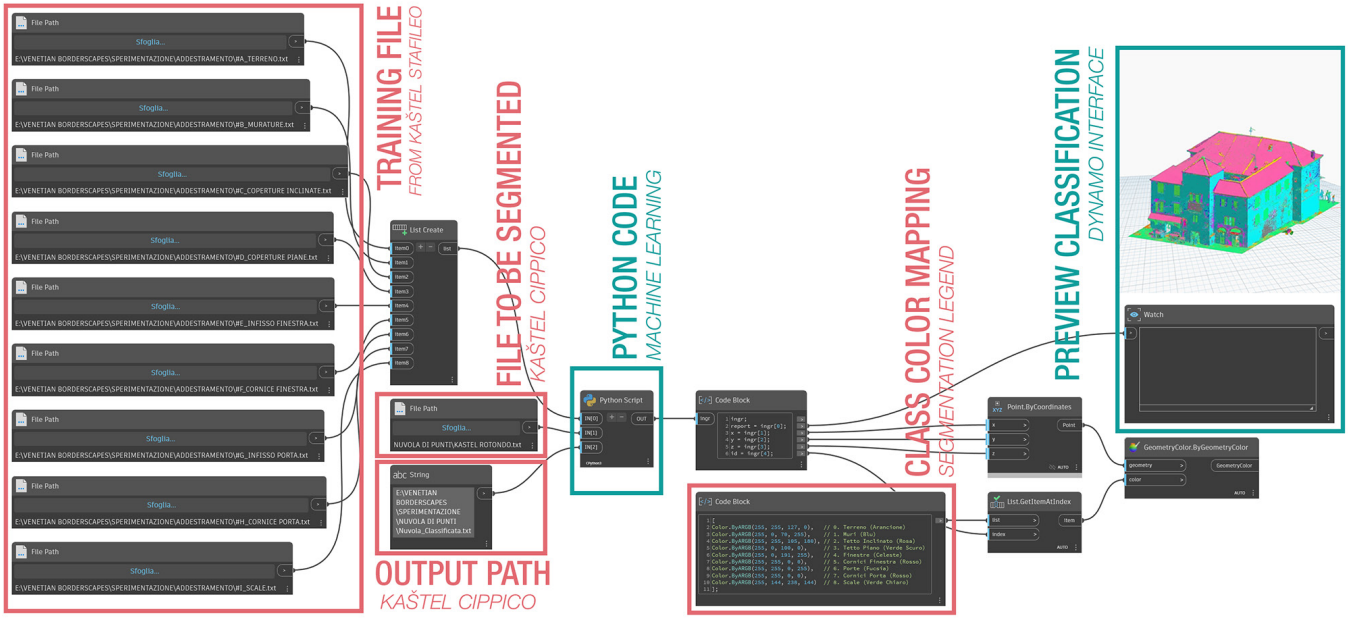


Fig. 7: Diagram of the node structure of the Dynamo workflow developed for the automatic classification of the Kaštel Cippico point cloud.

represent the identity of each constructive element. On this basis, the classification of the raw point cloud of Kaštel Cippico is tested: the algorithm analyzes each individual coordinate, determines its six-dimensional vector, and measures the Euclidean distance relative to the learned centroids, assigning it to the closest class. The raw output is immediately refined through spatial smoothing, a proximity filter that organizes the three-dimensional space into a regular grid; by examining the neighborhood of each point within a predefined radius, the code eliminates isolated points and assigns them to the prevailing class within their sphere of proximity.
The process concludes with the export of a text file in which each coordinate receives its classification paired with a new color coding, generating a dataset ready to be imported into point cloud management software and subdivided into functional regions for subsequent modeling operations. This step demonstrates the operation of the algorithm between typologically similar architectures, eliminating dependency on external libraries and ensuring logical-mathematical control over every classification phase.

A synthesis model for understanding the temporal relationships of Dalmatian fortified heritage

The use of three-dimensional digital models as the matrix and aggregative core of the information system makes it possible to structure cognitive experiences capable of going beyond traditional projective

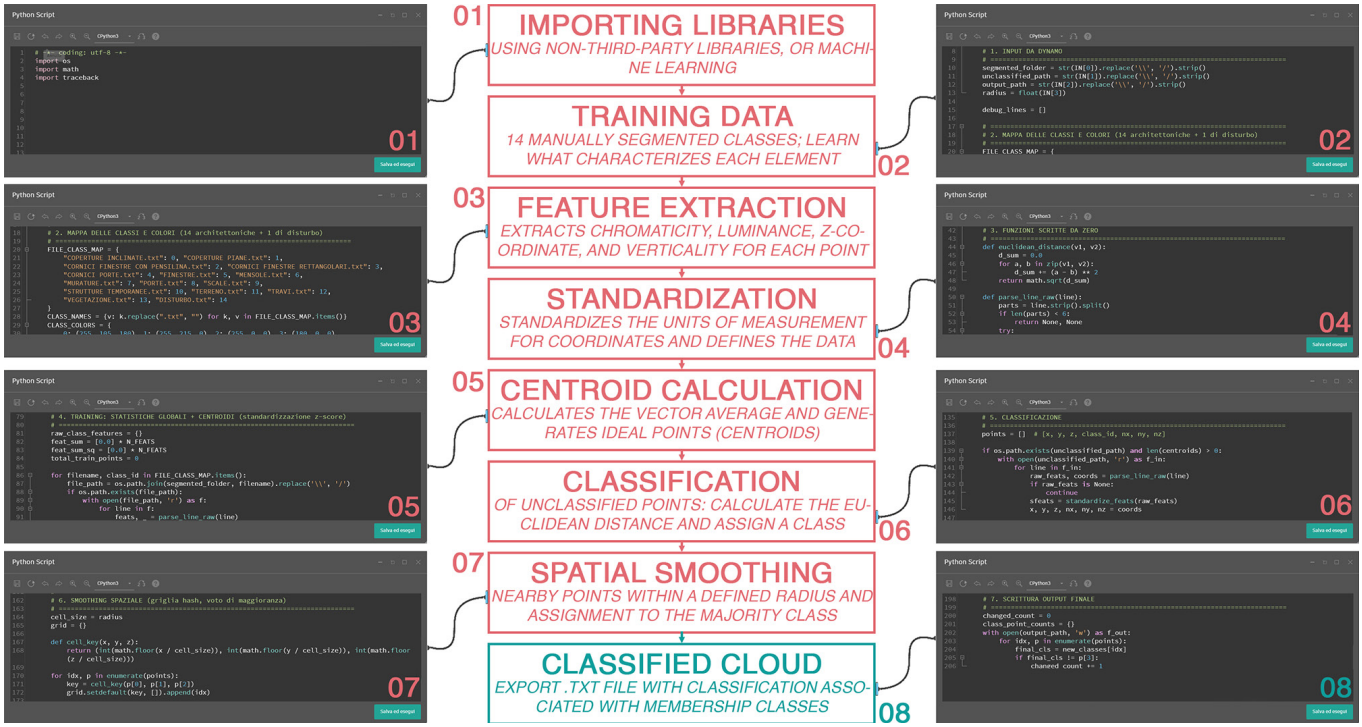


Fig. 8: Conceptual diagram of the workflow implemented in Python for the automatic classification of the point cloud.

visualization with a purely iconic representation[18]. The three-dimensional digital model of an object is no longer a single body observable from multiple viewpoints, but an organism composed of various parts, each of which can be represented in different ways and endowed with various attributes (geometric, material, compositional, constructive), depending on what needs to be read and interpreted[19]. The development of these digital methodologies finds application in BIM (Building Information Modeling) systems, designed to solve issues related to the documentation of historic buildings and their maintenance over time. The logic is based on transforming the three-dimensional model into a dynamic database, in which geometry becomes the supporting structure of a cognitive system of spatial information, open to continuous modifications and implementations[20].

In the case study, once the point cloud of Kaštel Cippico was segmented and exported, the reconstruction phase was initiated within the digital BIM environment. The

[18] S. Parrinello and A. Dell'Amico, "From Survey to Parametric Models: HBIM Systems for Enrichment of Cultural Heritage Management," in *From Building Information Modelling to Mixed Reality* (Cham: Springer International Publishing, 2020), 89–107.

[19] M. Gaiani, B. Benedetti, and F. I. Apollonio, "Teorie per rappresentare e comunicare i siti archeologici attraverso modelli critici," *SCIRES-IT: SCientific REsearch and Information Technology* 1, no. 2 (2011): 33–70.

[20] G. Pancani and M. Carissimo, "Scan-to-HBIM Approach for Digital Management and Virtual Fruition," *Heritage* 9, no. 4 (2026): 151.

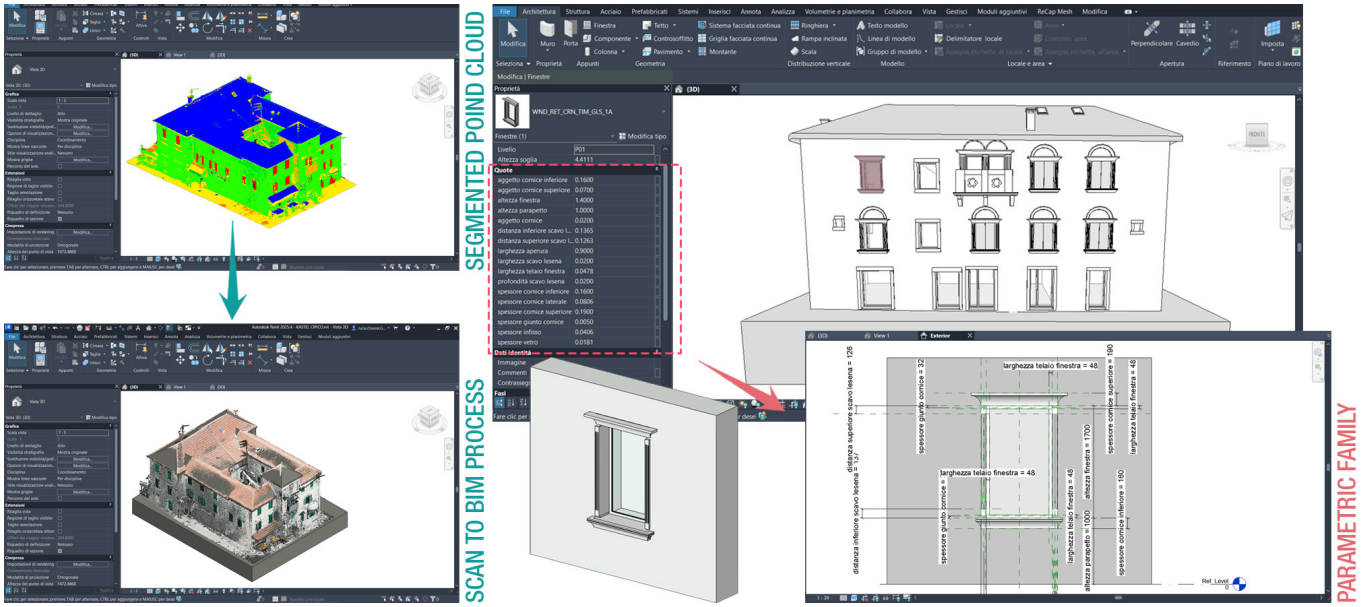


Fig. 9: Conceptual diagram of the Scan-to-BIM process and the construction of the parametric component library.

automatic classification of point sets simplified those interpretive processes that are often complex and risk extending modeling times. Engaging with built heritage means grappling with the rigidity of modeling software, designed for new construction and oriented toward standardized geometries. The process begins with the insertion of the segmented cloud and the modeling of individual elements. The identification of reference levels and grids formed the basis for correctly positioning and constraining each component of the model. At the same time, the creation of a naming system made it possible to catalog each component in an orderly manner, facilitating the subsequent decomposition of the building into its various historical phases.

To this cataloging and dimensional geometric properties is added a dedicated structure of historical-documentary parameters. This information can be queried directly within the modeling environment or exported in the open IFC interchange format. These attributes include the *Chronological Phase* - set up to distinguish the founding in 1481, the renovation after the fire of 1492, the subdivision of 1831, and the current state at the time of the survey - the *Archival Source*, used to link individual elements to historical land registries, and the *Degree of Reliability*, connected to the level of certainty of the reconstructive attribution. In addition, data on the *State of Conservation* and the *Material Characterization* of the surfaces are linked to this information framework.

The presence of recurring serial elements in the structure guided the development of parametric families based on fixed geometric rules. Although identifying the constraints governing these forms required a careful analysis and processing phase, their use optimized the representation of the entire complex. This process built an object library capable of adapting to the building's specificities and reusable for the digitization of other coeval *kaštel*-palaces.

Digital visualization within BIM-authoring software allows for analysis in archival and documentary consulting practices, integrating drawings, photographs,

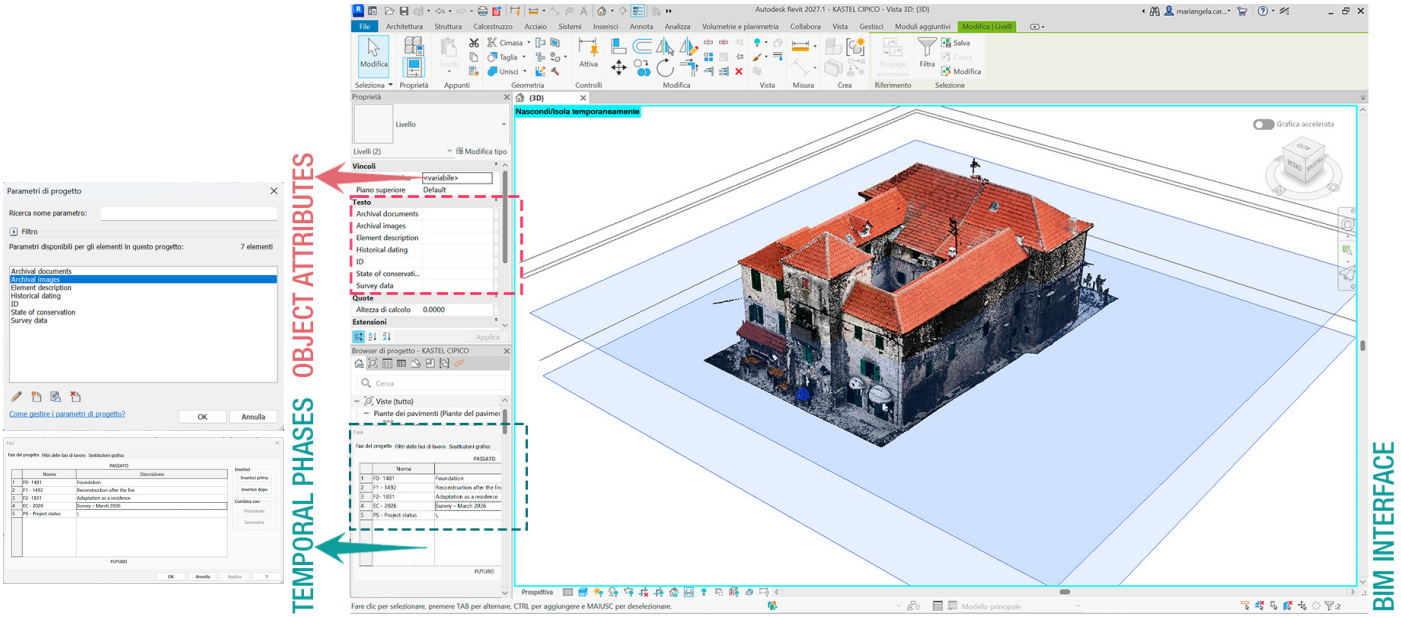


Fig. 10: Conceptual diagram of the information enrichment of the model through the definition of temporal phases and object attributes.

texts, and qualitative or chronological data into a single environment[21]. Having first addressed the representation of the building's current state, the model of Kaštel Cippico stands as an example of four-dimensional modeling, in which the fourth dimension is expressed by the building's chronological phases. By querying the information system through specific phase filters, it becomes possible to isolate architectural components and trace their evolution backward, distinguishing nineteenth-century alterations from the Renaissance renovation of 1492, all the way back to the elements of the original structure commissioned by Coriolano Cippico in 1481.

Conclusion

The considerations that emerge from the transition from morphometric data to the digital model highlight the role of established survey and digital representation practices in relation to the opportunities offered by parametric modeling protocols.

The autonomy defined by the Machine Learning script and the exclusion of third-party external libraries make it possible to manage the code's entire logical-mathematical framework, grounding point cloud decomposition on the redundancy of typological features from the Venetian tradition. The implementation and testing of such automated modeling procedures may at times deviate from the millimeter metric tolerances required in specific fields, while nevertheless remaining within geometric margins suitable for achieving the project's cognitive and documentary goals, such as the temporal attribution of constituent architectural parts. The transfer of information for initial data classification, validated in the transition from Kaštel Stafileo to Kaštel Cippico, documents the feasibility of a scalable

[21] L. Chiavacci, G. Dellabartola, and A. Pettineo, "Scan-to-BIM per l'analisi del patrimonio architettonico-paesaggistico dell'isola di Santo Spirito a Venezia," *DISEGNO* (2025): 577–600.

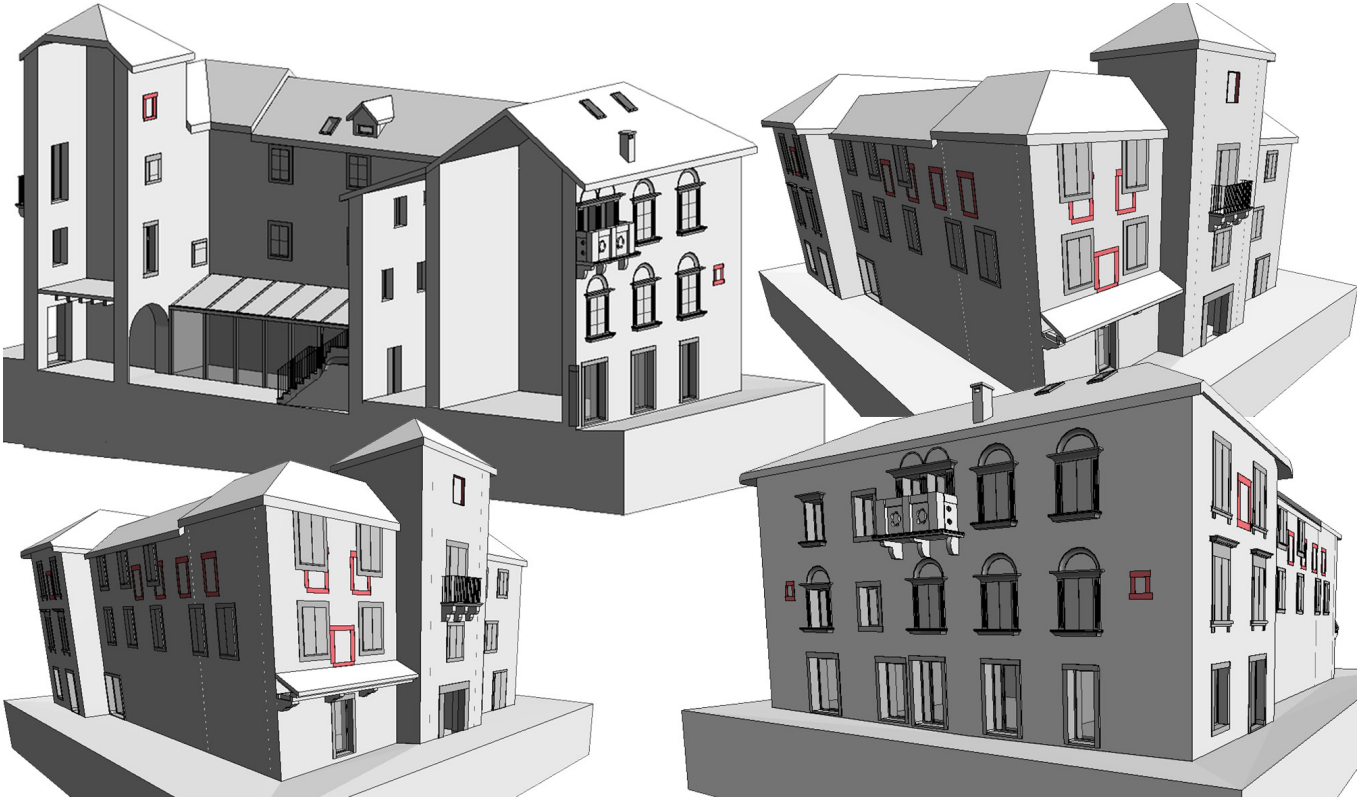


Fig. 11: Views of the BIM model highlighting the stone elements embedded in the building's masonry.

approach, potentially extendable to the entire system of fortifications along the Dalmatian coast.

In this sense, the possibility of reusing parametric families to model other coeval complexes with similar stylistic features makes it possible to guide the representational processes of Venetian *kaštel*-palaces. The automatic segmentation of data, which aligns with the logic of the language underlying BIM - where each element possesses attributes linking it to its typological class - optimizes the three-dimensional reconstruction phase.

Through future investigations into archival sources, the information infrastructure will be able to accommodate further chronological insights, describing in even greater detail the transformations undergone by the building over the centuries, from its past as a military outpost to its current state. Structuring an expandable database, enriched with shared historical-documentary parameters queryable in the open IFC format, transforms the three-dimensional model into a multi-dimensional structure extended through time, capable of documenting the various centuries of the building's alterations down to isolating its original fifteenth-century configuration.

The information system defines a methodology capable of going beyond geometric reproduction to integrate complex data - such as material characteristics or topological relationships between parts - offering a foundation for broad-spectrum analysis in the field of architectural conservation and restoration.

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EXHIBITION & PHOTOGALLERY

THE DESIGN OF AN EXHIBITION FOR FORTIFIED HERITAGE BETWEEN ITALY AND CROATIA

The Venetian Borderscapes exhibition was conceived to communicate an architectural heritage whose geographical extent and history encompass both shores of the Adriatic, bringing their connections into a shared narrative. The fortified settlements examined in the research are now part of the landscape and everyday life of Croatian communities, while their development retains links with the history and circulation of architectural models and building practices associated with the Republic of Venice. The decision to create a travelling exhibition, intended for display in Croatia and Italy, reflects the aim of making these connections accessible to different audiences, bringing the research findings back to the territories they concern and opening them to wider discussion across the two exhibition settings.

These two destinations informed the graphic design from the outset, shaping the arrangement of both textual and visual content. The layout was conceived as a narrative unit capable of retaining its distinctive identity and functioning independently in different exhibition settings, while accommodating texts in both Italian and Croatian. The arrangement of content had to allow the two versions to coexist within the same panel while maintaining a clear relationship between written explanations and visual material. Bilingualism thus became integral to the composition of each panel and its visual hierarchy, helping to establish a shared graphic system suitable for both contexts and consistent throughout the exhibition.

The exhibition narrative was organised into three parts, maintained across both venues. The first presents the digital documentation activities, introducing the work through which the buildings were observed, surveyed and represented during field research campaigns. The second examines the history of the Kaštel system, providing the context needed to understand its development and relationship with the territory. The third focuses on the documented case studies, in which historical research and digital surveying contribute to interpreting transformations and proposing reconstructions of earlier configurations. Taken together, these three parts establish a sequence that guides visitors from the production of documentation through the historical context to the interpretation of individual complexes.

In the section devoted to the case studies, visual representations play an argumentative role. The relationship between sources, surveys and reconstruction hypotheses makes it possible to show how a particular interpretation of the architecture was reached, making the reasoning behind that interpretation accessible to visitors. Within this section, the panels follow a typological organisation that distinguishes

between settlement, palace and tower. An important reference was Katja Marasović's volume *Kaštelanski kašteli*, whose extensive analyses, interpretations and reconstruction proposals provided a basis for further investigation. The interpretations developed for the exhibition build on this work, revisiting its questions through the possibilities for observation, measurement and representation offered by digital documentation.

As discussed in the preceding contributions, these elements form parts of complexes in which a seigneurial residence, sometimes taking the form of a tower, is associated with a walled settlement. The three categories therefore offer distinct perspectives on a system of relationships. The Seget case study introduces the settlement scale, focusing on the inhabited core and its organisation; the cases devoted to towers and the palace examine individual buildings and their relationship with their surroundings.

The graphic design supports the transition between these scales of interpretation, maintaining their connection within the overall narrative. Overall views allow visitors to recognise the configuration of the complexes, while analytical representations and reconstructions draw attention to relationships between their constituent parts and to their transformations. The text accompanies this sequence, providing the information needed to interpret what is shown. The panel thus becomes the medium through which research content and structure are translated into a sequence accessible even to visitors encountering these places for the first time.

The chromatic identity relies on the juxtaposition of warm and cool tones, whose balance accommodates the variety of materials on display, provides visual continuity throughout the exhibition and supports the readability of its content.

Narrative and visual coherence are complemented by flexibility of use. At Porta Palio in Verona, the panels were mounted on existing modular display structures designed by Professor Sandro Parrinello's research group for previous exhibitions, including *3D SEBENICO – 3D Survey of Built Venetian Historic Fortresses*; at Barone Fortress in Šibenik, they were displayed on the permanent supports already installed in the fortress rooms. The layout therefore had to accommodate different display systems while preserving the identity of the sections and the continuity of the narrative in each venue.

The inclusion of the exhibition in this volume extends this approach through a different pace of consultation. The explanatory panels are reproduced on the following pages, where they can be read in sequence and considered alongside the essays. The introductory panels are distributed throughout the volume as

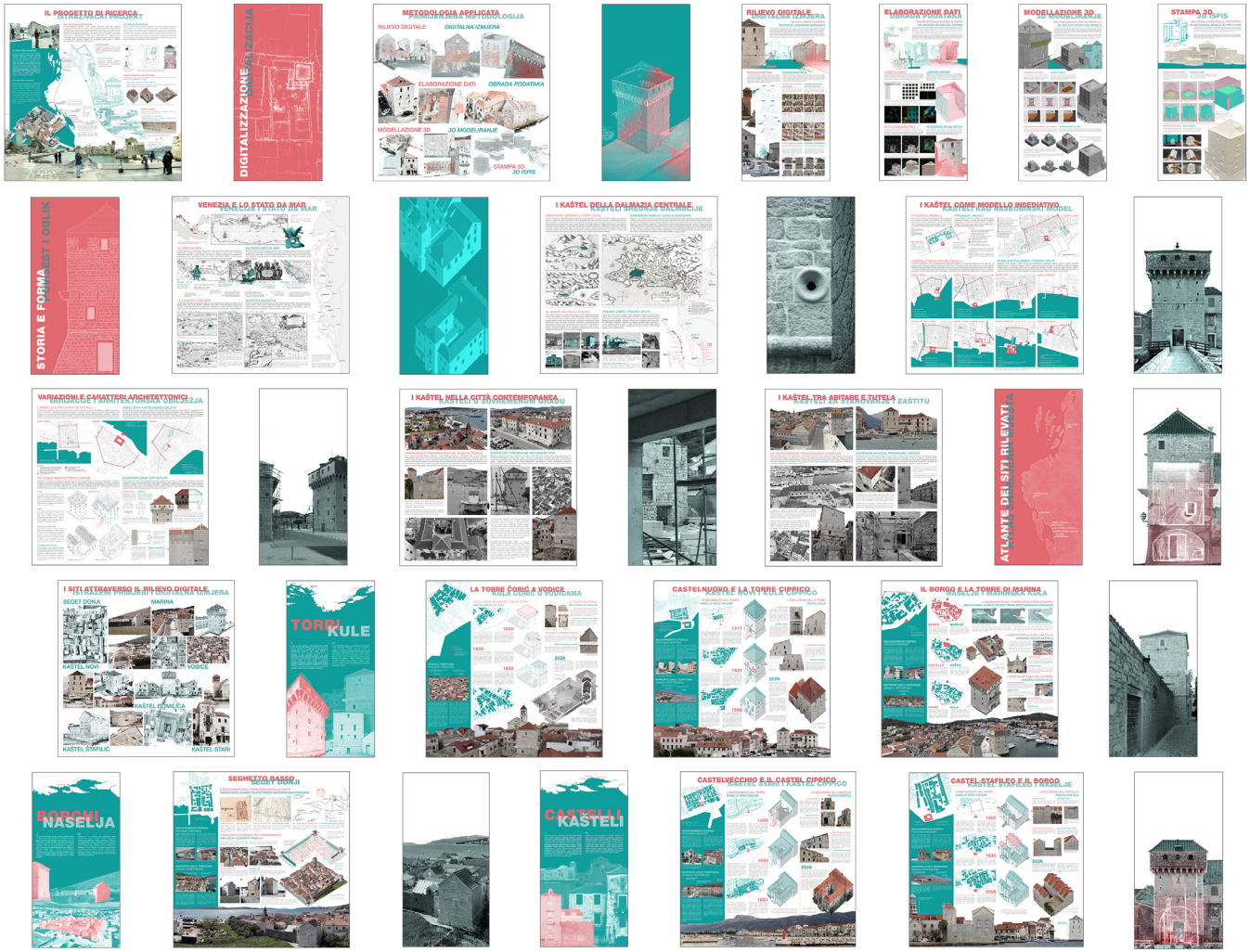


Fig. Overview of the exhibition narrative, with all panels arranged in sequence and grouped into thematic sections. The layout traces the progression from digital documentation methods to the historical and architectural context, followed by the individual case studies, showing how the panels build a connected account of the fortified settlements and their transformations.

opening pages for the contributions and, within the section devoted to the exhibition, as introductions to its different parts. The order of the exhibition narrative is shown in an overview image containing thumbnails of all the panels, arranged according to the exhibition sequence and grouped into their respective thematic sections. The elements that introduce and punctuate the route through the exhibition space thus also serve to guide readers through the structure of the book.

EXHIBITION PANELS





IL PROGETTO DI RICERCA
ISTRAŽIVAČKI PROJEKT



LE TAPPE DELLA RICERCA

La ricerca ha preso avvio da una ricognizione dei sistemi fortificati della Dalmazia centrale, integrando lo studio delle fonti storiche e cartografiche con l'analisi diretta dei manufatti. Nell'ambito territoriale compreso tra Spalato, Traù, Sebenico e Zara sono stati selezionati sette casi studio per il rilievo e la documentazione digitale, rappresentativi di diverse forme di difesa costiera: Castel Abbadessa, Castel Cippico a Kaštel Stari, Torre Cippico a Kaštel Novi, Castel Stafileo a Kaštel Štafilić, Marina, Seget e la Torre Ćorić a Vodice.

ISTRAŽIVAČKI ITINERAR

Istraživanje je započelo pregledom fortifikacijskih sustava srednje Dalmacije, povezujući proučavanje povijesnih i kartografskih izvora s neposrednom analizom građevina. Na području između Splita, Trogira, Šibenika i Zadra odabrano je sedam studija slučaja za digitalno snimanje i dokumentiranje, koje predstavljaju različite oblike obalne obrane: Opatičin kaštel u Kaštel Gomilici, kaštel Čipiko u Kaštel Starom, kula Čipiko u Kaštel Novom, kaštel Stafileo u Kaštel Štafiliću, Marina, Seget i kula Ćorić u Vodicama.

DAL RILIEVO ALLA NARRAZIONE

La documentazione digitale è stata condotta integrando rilievi laser scanner, fotogrammetria terrestre e acquisizioni UAV, per registrare geometrie e caratteristiche morfometriche del patrimonio fortificato attraverso nuvole di punti e immagini ad alta risoluzione. Per ciascun caso studio, i dati acquisiti sono stati integrati in un unico modello tridimensionale georeferenziato, assunto come base conoscitiva per l'analisi dello stato di conservazione, lo studio storico-architettonico e il confronto con la cartografia storica. Dai modelli sono stati inoltre ricavati planimetrie, sezioni, prospetti e prototipi fisici mediante stampa 3D, a supporto delle attività di ricerca, interpretazione e valorizzazione del patrimonio.

OD IZMJERE DO NARACIJE

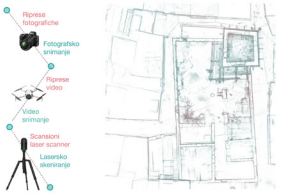
Digitalna dokumentacija provedena je integracijom laserskog skeniranja, terestričke fotogrametrije i UAV snimanja, radi bilježenja geometrije i morfometrijskih obilježja utvrđene baštine putem oblaka točaka i snimaka visoke rezolucije. Za svaki studijski slučaj prikupljeni su podaci objedinjeni u jedinstveni georeferencirani trodimenzionalni model, koji je poslužio kao spoznajna osnova za analizu stanja očuvanosti, povijesno-arhitektonska istraživanja i usporedbu s povijesnom kartografijom. Iz modela su također izvedeni tlocrti, presjeci, pročelja i fizički prototipovi izrađeni 3D ispisom, kao potpora istraživanju, interpretaciji i valorizaciji baštine.

RILIEVO DIGITALE

Acquisizione integrata mediante laser scanning e fotogrammetria per la restituzione tridimensionale del patrimonio architettonico.

DIGITALNA IZMJERA

Integrirano snimanje laserskim skeniranjem i fotogrametrijom za trodimenzionalnu dokumentaciju arhitektonske baštine.



Strumentazione impiegata
Korištena oprema.

Planimetria e sezione trasversale estratte dalla nuvola di punti integrata.
Tlocrt i poprečni presjek izvedeni iz integriranoga oblaka točaka.

ANALISI TIPOLOGICA E ARCHITETTONICA

Classificazione degli edifici per caratteri costruttivi, formali e funzionali ricorrenti, dalla torre all'insediamento fortificato.

TIPOLOŠKA I ARHITEKTONSKA ANALIZA

Klasifikacija građevina prema ponavljajućim konstruktivnim, oblikovnim i funkcionalnim obilježjima, od kule do utvrđenog naselja.



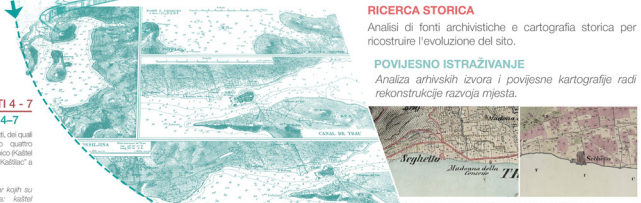
Confronto tipologico: dalla torre all'insediamento fortificato.
Tipološka usporedba: od kule do utvrđenog naselja.

RICERCA STORICA

Analisi di fonti archivistiche e cartografia storica per ricostruire l'evoluzione del sito.

POVIJESNO ISTRAŽIVANJE

Analiza arhivskih izvora i povijesne kartografije radi rekonstrukcije razvoja mjesta.



Confronto tra cartografia militare e catastale dal XIX secolo.
Usporedba vojne i katastarske kartografije 19. stoljeća.

DIGITALIZZAZIONE

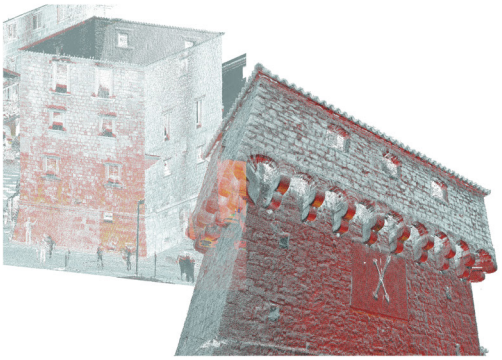
DIGITALIZACIJA



METODOLOGIA APPLICATA
PRIMIJENJENA METODOLOGIJA

RILIEVO DIGITALE
DIGITALNA IZMJERA



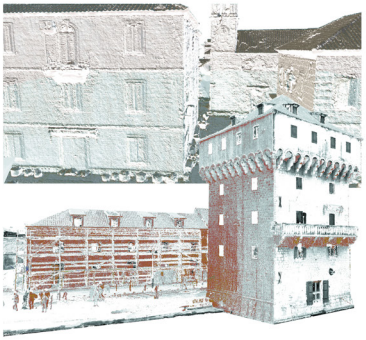
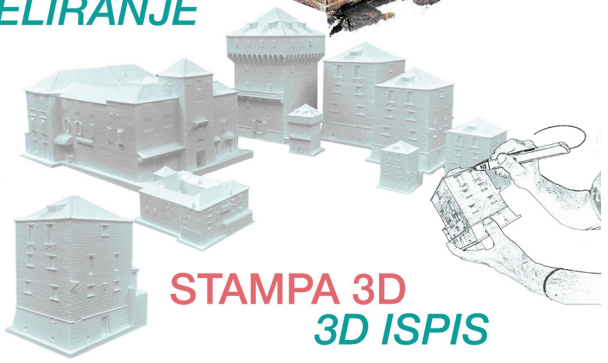


ELABORAZIONE DATI
OBRADA PODATAKA





MODELLAZIONE 3D
3D MODELIRANJE

STAMPA 3D
3D ISPIS

RILIEVO DIGITALE
DIGITALNA IZMJERA

RILIEVO LASER SCANNER
SNIMANJE LASERSKIM SKENEROM

Le attività di rilevamento mediante laser scanner consentono di acquisire dati morfometrici relativi agli oggetti architettonici e al loro contesto. Le diverse scansioni vengono integrate in un'unica nuvola di punti tridimensionale ad alta risoluzione, capace di restituire nel dettaglio forme, proporzioni e relazioni spaziali. Il dato costituisce la base per l'analisi morfologica, per la successiva integrazione con il dato fotogrammetrico e per la produzione di planimetrie, sezioni, prospetti e modelli 3D.

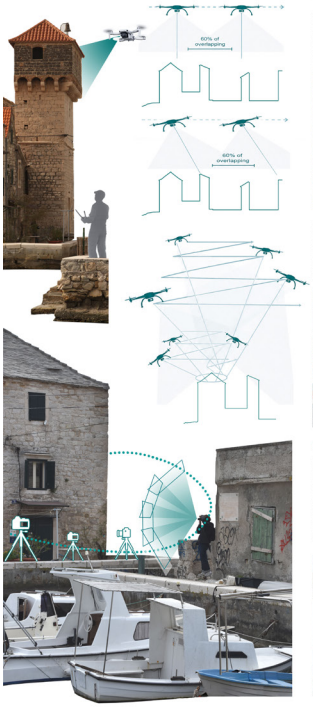
Aktivnosti izmjere pomoću laserskog skenera omogućuju prikupljanje morfometrijskih podataka o arhitektonskim objektima i njihovu kontekstu. Pojedinačna skeniranja objedinjuju se u jedinstveni trodimenzionalni oblak točaka visoke rezolucije, koji detaljno prikazuje oblike, proporcije i prostorne odnose. Dobiveni podaci predstavljaju osnovu za morfološku analizu, naknadnu integraciju s fotogrametrijskim podacima te izradu tlocrta, presjeka, pročelja i 3D modela.



FOTOGRAMMETRIA
FOTOGRAMETRIJA

La fotogrammetria ricostruisce la geometria tridimensionale di un oggetto a partire da sequenze di immagini, acquisite da differenti punti di vista e con un'adeguata sovrapposizione. L'elaborazione delle immagini consente di generare nuvole di punti tridimensionali, utilizzate come supporto e integrazione al dato acquisito mediante laser scanner. Dall'integrazione dei diversi dataset è possibile ottenere modelli 3D, in grado di restituire geometrie, caratteristiche superficiali e parti dell'architettura difficilmente accessibili.

Fotogrametrija rekonstruira trodimenzionalnu geometriju objekta na temelju niza snimaka, snimljenih iz različitih položaja uz odgovarajuće međusobno preklapanje. Obradom snimaka moguće je generirati trodimenzionalne oblake točaka, koji služe kao dopuna i integracija podataka prikupljenih laserskim skeniranjem. Integracijom različitih skupova podataka moguće je izraditi trodimenzionalne modele visoke rezolucije, sposobne dokumentirati geometriju, obilježja površina i teško dostupne dijelove arhitekture.



FOTOGRAMMETRIA DA DRONE
FOTOGRAMETRIJA DRONOM

SISTEMI DISTRIBUITI

Per la documentazione di sistemi architettonici estesi, le acquisizioni UAV sono condotte mediante piani di volo impostati secondo griglie regolari, combinando riprese nadirali e oblique incrociate.

PROSTORNO RAZVIJENI SUSTAVI

Za dokumentiranje prostornih arhitektonskih sustava UAV snimanja provode se prema planovima leta postavljenima u pravilnim mrežama, kombinirajući nadirne i međusobno ukrižane kose snimke.



ELEMENTI PUNTUALI

Per la documentazione di singoli elementi architettonici, le acquisizioni UAV sono impostate mediante punti di interesse, attorno ai quali vengono sviluppate traiettorie circolari a quote e inclinazioni differenti, così da garantire una copertura omogenea dell'intero manufatto.

POJEDINAČNI ARHITEKTONSKI ELEMENTI

Za dokumentiranje pojedinačnih arhitektonskih elemenata UAV snimanja planiraju se pomoću točaka interesa, oko kojih se izvode kružne putanje na različitim visinama i s različitim nagibima kamere, kako bi se osigurala ujednačena pokrivenost cijele građevine.



FOTOGRAMMETRIA DA TERRA
TERESTRIČKA FOTOGRAMETRIJA

Le acquisizioni fotogrammetriche da terra sono realizzate mediante sequenze di immagini ravvicinate e parzialmente sovrapposte, secondo lo stesso principio delle acquisizioni UAV, riprese da posizioni, quote e inclinazioni differenti. Questa strategia consente di documentare con elevato dettaglio superfici, apparecchi murari ed elementi architettonici, integrando la documentazione tridimensionale complessiva.

Terestrička fotogrametrijska snimanja provode se nizovima bliskih i djelomično preklapajućih snimaka, prema istom načelu kao i UAV snimanja, snimljenih s različitih položaja, visina i nagiba. Ova strategija omogućuje detaljno dokumentiranje površina, struktura zida i arhitektonskih elemenata, nadopunjujući cjelokupnu trodimenzionalnu dokumentaciju.



ELABORAZIONE DATI
OBRADA PODATAKA

DAL RILIEVO ALLA NUVOLA DI PUNTI
OD IZMJERE DO OBLAKA TOČAKA

I dati acquisiti mediante laser scanner e fotogrammetria vengono elaborati in ambienti software dedicati. Le scansioni vengono registrate in un unico sistema di riferimento, filtrate e successivamente verificate per individuare eventuali errori di registrazione. Il processo di elaborazione fotogrammetrica consente invece di ottenere nuvole di punti che possono essere integrate al dato laser scanner per pervenire a un'unica banca dati tridimensionale ad alta risoluzione, oppure modelli mesh destinati alle successive fasi di modellazione e stampa 3D.

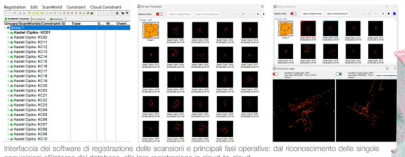
Podaci prikupljeni laserskim skeniranjem i fotogrametrijom obrađuju se u specijaliziranim softverskim okruženjima. Pojedinačna skeniranja registriraju se u jedinstvenom referentnom sustavu, filtriraju te se naknadno provjeravaju radi utvrđivanja mogućih pogrešaka registracije. Fotogrametrijska obrada omogućuje izradu oblaka točaka koji se mogu integrirati s podacima laserskog skeniranja kako bi se dobila jedinstvena trodimenzionalna baza podataka visoke rezolucije, ili mesh modela namijenjenih sljedećim fazama modeliranja i 3D ispisa.



LASER SCANNER
LASERSKI SKENER

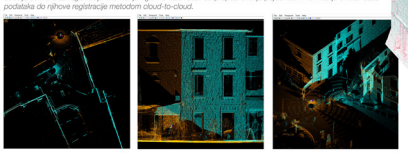
Le singole scansioni vengono allineate mediante processi di cloud-to-cloud e verificate rispetto agli errori residui. Il confronto tra le porzioni sovrapposte delle diverse scansioni consente di controllare la corretta registrazione e la coerenza geometrica complessiva della nuvola di punti. Durante le fasi di filtraggio vengono eliminati porzioni incoerenti e dati non pertinenti, migliorando la qualità e la leggibilità della nuvola di punti.

Pojedinačna skeniranja poravnavaju se postupcima cloud-to-cloud registracije i provjeravaju s obzirom na preostale pogreške. Usporedba preklapajućih dijelova različitih skeniranja omogućuje kontrolu ispravnosti registracije i ukupne geometrijske usklađenosti oblaka točaka. Tijekom faza filtriranja uklanjaju se nekoherentni dijelovi i nerelevantni podaci, čime se poboljšavaju kvaliteta i čitljivost oblaka točaka.



Interfaccia del software di registrazione delle scansioni e principali fasi operative: dal riconoscimento delle singole acquisizioni all'interno del database, alla loro registrazione in cloud-to-cloud.

Sučelje softvera za registraciju skeniranja i glavne faze rada: od prepoznavanja pojedinačnih snimanja unutar baze podataka do njihove registracije metodom cloud-to-cloud.





SET FOTOGRAMMETRICI
FOTOGRAMETRIJSKI SETOVI

Il processo di allineamento fotogrammetrico prende avvio dall'orientamento dei set fotografici mediante l'individuazione e la correlazione di punti omologhi tra immagini sovrapposte. L'allineamento consente di stimare posizione e orientamento delle camere e di ricostruire la geometria tridimensionale dell'oggetto. Il modello viene quindi scalato sulla base del dato metrico laser scanner e integrato con la relativa nuvola di punti.

Proces fotogrametrijskog poravnavanja započinje orijentacijom skupova fotografija putem prepoznavanja i korelacije homologih točaka između preklapajućih snimaka. Poravnanje omogućuje procjenu položaja i orijentacije kamera te rekonstrukciju trodimenzionalne geometrije objekta. Model se zatim skalira na temelju metričkih podataka laserskog skeniranja i integrira s odgovarajućim oblakom točaka.



Interfaccia del software fotogrammetrico: allineamento delle immagini, controllo di accuratezza, scalatura del modello su punti omologhi rispetto al dato laser scanner e ricostruzione 3D.

Sučelje fotogrametrijskog softvera: poravnanje snimaka, kontrola točnosti, skaliranje modela prema homolognim točkama u odnosu na podatke laserskog skeniranja i 3D rekonstrukcija.



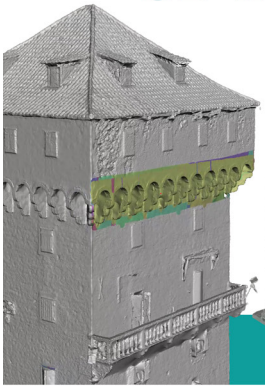


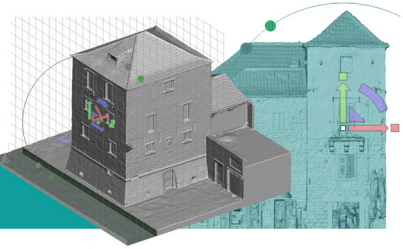
MODELLAZIONE 3D
3D MODELIRANJE

DALLA NUVOLA DI PUNTI AL MODELLO
OD OBLAKA TOČAKA DO MODELA

La modellazione 3D viene sviluppata attraverso processi di scan-to-model, utilizzando come riferimento metrico la nuvola di punti ottenuta dalle attività di rilievo. A partire dal modello mesh elaborato e scalato a partire dalla nuvola di punti, vengono ricostruite e interpretate le geometrie dell'architettura. Il modello viene quindi sottoposto a operazioni di pulizia, correzione e ottimizzazione geometrica, necessarie alla successiva preparazione per la stampa 3D.

3D modeliranje razvija se kroz procese scan-to-model, pri čemu se kao metrička referenca koristi oblak točaka dobiven aktivnostima izmjere. Polazeći od mesh modela izrađenog i skaliranog na temelju oblaka točaka, rekonstruiraju se i interpretiraju geometrije arhitekture. Model se zatim podvrgava postupcima čišćenja, korekcije i geometrijske optimizacije, potrebnima za daljnju pripremu za 3D ispis.



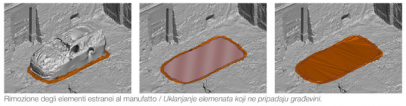


CORREZIONE DELLA MESH

Dal modello vengono rimossi automobili, segnaletica, arredi e altri elementi estranei all'architettura. Le lacune e le geometrie non correttamente ricostruite vengono chiuse o ridisegnate, intervenendo localmente sulla mesh senza alterare la configurazione generale del manufatto.

KOREKCIJA MREŽA

Iz modela se uklanjaju automobili, prometni znakovi, urbana oprema i drugi elementi koji ne pripadaju arhitekturi. Praznine i nepravilno rekonstruirane geometrije zatvaraju se ili ponovno modeliraju lokalnim zahvatima na mreži, bez promjene opće konfiguracije građevine.



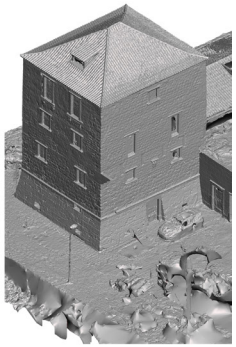
Rimozione degli elementi estranei al manufatto / *Uklanjanje elemenata koji ne pripadaju građevini.*



Ricostruzione delle aperture e delle parti mancanti / *Rekonstrukcija otvora i nedostajućih dijelova.*



Correzione e regolarizzazione delle superfici attraverso sculpting digitale / *Korekcija i ujednačavanje površina.*



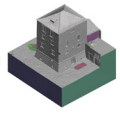
PREPARAZIONE DEL MODELLO ALLA STAMPA

Terminata la correzione geometrica, la mesh viene resa chiusa e continua, eliminando fori, elementi scollegati ed errori topologici. Vengono quindi definiti la base e i limiti del modello, ottenendo una geometria solida e controllata per la successiva stampa 3D.

PRIPREMA MODELA ZA ISPIS

Nakon završetka rekonstrukcije i geometrijske korekcije, mreža se zatvara i čini kontinuiranom uklanjanjem otvora, odvojenih elemenata i topoloških pogrešaka. Model se zatim provjerava i prilagođava zahtjevima prototipiranja, definirajući njegovu bazu, granice i dijelove namijenjene naknadnom 3D ispisu.





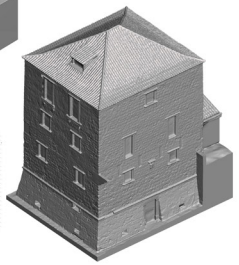
Le operazioni di pulizia possono lasciare piccoli elementi separati, discontinuità o aperture nella mesh. Queste anomalie vengono individuate e corrette, verificando la continuità delle superfici e ottenendo un modello geometricamente chiuso e coerente.

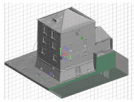
Postupci čišćenja mogu ostaviti manje odvojene elemente, diskontinuitete ili otvore u mreži. Te se nepravilnosti identificiraju i ispravljaju, uz provjeru kontinuiteta površina, kako bi se dobio geometrijski zatvoren i koherentan model.

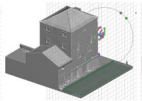


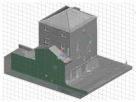
Modello chiuso e ottimizzato, pronto per l'esportazione nel software di stampa 3D.

Zatvoren i optimiziran model, spreman za izvoz u softver za 3D ispis.









Definizione dei piani di taglio in funzione del volume massimo di stampa.

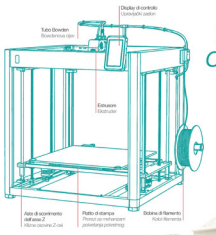
Definiranje ravnina rezanja prema maksimalnom volumenu ispisa.

STAMPA 3D
3D ISPIS

DAL MODELLO DIGITALE AL PROTOTIPO
OD DIGITALNOG MODELA DO PROTOTIPA

La stampa 3D traduce il modello digitale in un prototipo fisico mediante un processo di deposizione additiva per strati, adottato dalle stampanti utilizzate. Il modello viene scalato, orientato e preparato in un software di slicing, nel quale vengono definiti pareti, riempimenti, supporti e parametri di stampa. La prototipazione consente di confrontare fisicamente geometrie e caratteri architettonici dei diversi casi studio.

3D ispis pretvara digitalni model u fizički prototip postupkom aditivnog taloženja sloj po sloj, koji primjenjuju korišteni pisači. Model se skalira, orijentira i priprema u softveru za slicing, u kojem se definiraju stijenke, ispuna, potporne strukture i parametri ispisa. Prototipiranje omogućuje fizičku usporedbu geometrija i arhitektonskih obilježja različitih studija slučaja.



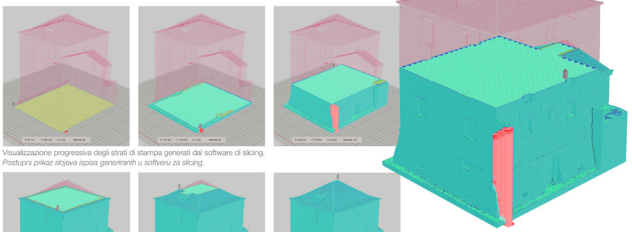


PREPARAZIONE ALLA STAMPA

Nel software di slicing il modello viene orientato rispetto al piano di stampa e suddiviso in strati. Vengono impostati gli spessori delle pareti, il riempimento interno e i supporti necessari per le parti aggettanti, verificando stabilità e leggibilità dei dettagli.

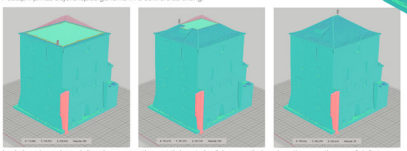
PRIPREMA ZA ISPIS

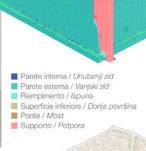
U softveru za slicing model se orijentira u odnosu na plohu ispisa i dijeli na slojeve. Definiraju se debljine stijenki, unutarnja ispuna i potporne strukture potrebne za istaknute dijelove, uz provjeru stabilnosti i detaljnosti detalja.



Visualizzazione progressiva degli strati di stampa generati dal software di slicing.

Postupni prikaz slojeva ispisa generiranih u softveru za slicing.





- Parete interna / *Unutarnji zid*
- Parete esterna / *Vanjski zid*
- Riempimento / *Ispuna*
- Superficie inferiore / *Donja površina*
- Ponte / *Most*
- Supporto / *Potpora*

I colori corrispondono ai diversi componenti generati durante lo slicing: pareti, riempimenti, supporti e superfici di stampa.

Boje odgovaraju različitim elementima generiranima tijekom slicinga: stijenkama, ispunama, potpornim strukturama i ispisnim površinama.

RIFINITURA DEL MODELLO

Durante la stampa il filamento viene depositato progressivamente secondo il percorso calcolato. Al termine, il prototipo viene separato dal piano, liberato dai supporti e rifinito manualmente.

DORADA MODELA

Tijekom ispisa filament se postupno nanosi prema izračunatoj putanji. Po završetku, prototip se odvaja od podloge, uklanjaju se potporne strukture te se ručno dorađuje.





Stampa e primo controllo visivo / *Ispis i početna vizualna kontrola*





Pulizia e rifinitura manuale / *Ručno čišćenje i dorada*



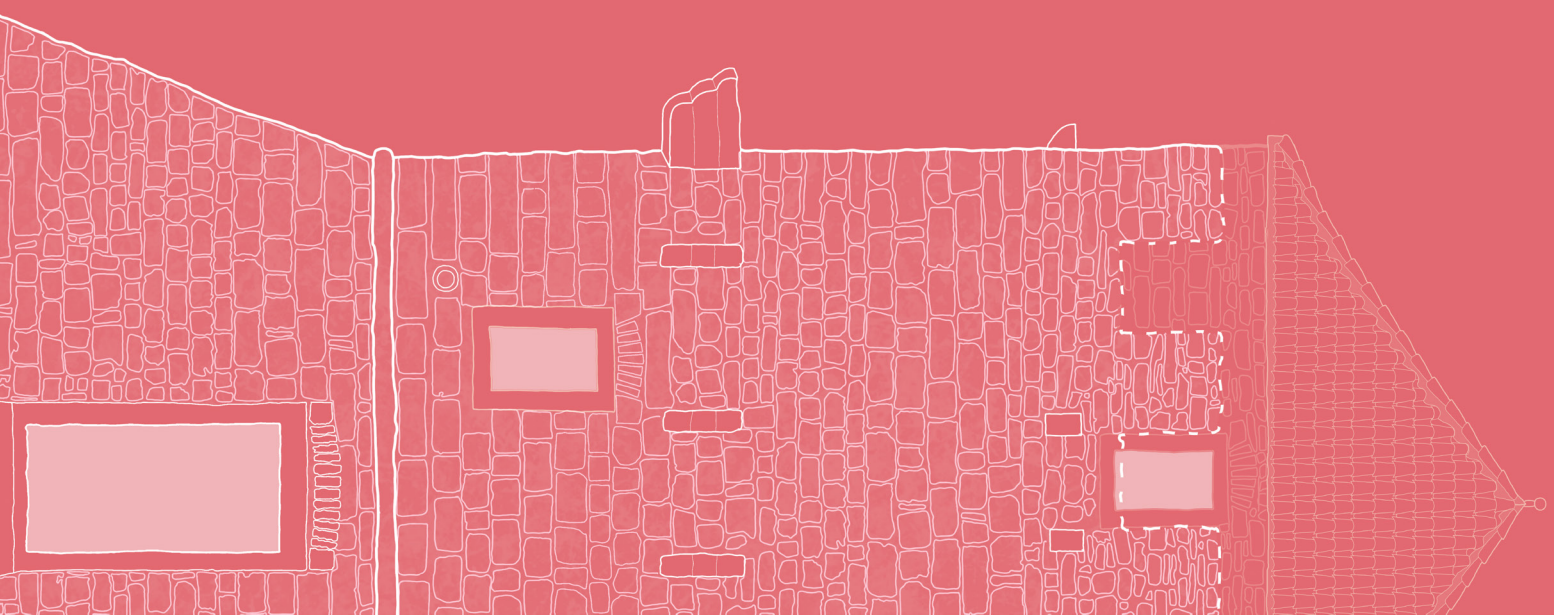


Assemblaggio e completamento / *Spajanje i dovršetak*



STORIA E FORMA

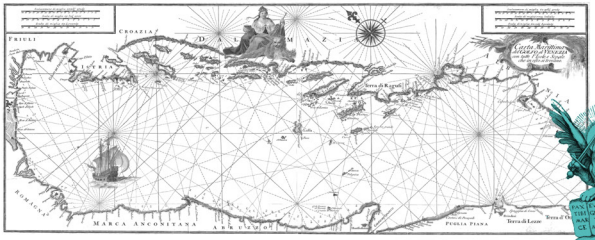
POVIJEST I OBLIK



VENEZIA E LO STATO DA MAR
VENECIJA I STATO DA MAR



Territori e aree d'influenza della Serenissima Repubblica di Venezia
Teritorij i područja utjecaja Mletačke Republike



L'Adriatico come "Golfo di Venezia" / *Jadran kao "Mletački zaljev."*

Rielaborazione grafica da / *Grafička prerada prema:* G. Tentivo, Carta Marittima del Golfo di Venezia [...], Venezia, c. 1740. Collezione privata Marco Asta, Bologna.

LO STATO DA MAR

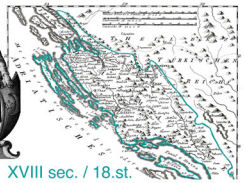
Lo Stato da Mar era un arcipelago politico di città, isole e giurisdizioni distribuite dall'Adriatico al Mediterraneo orientale. A tenerlo insieme era una trama di rotte e porti commerciali, insediamenti fortificati e grandi fortezze, attraverso cui Venezia proteggeva la navigazione e proiettava la propria autorità verso il Levante. Questa sovranità si costruiva anche mediante accordi con le comunità e le élite locali, che conservarono statuti e consuetudini.

MLETAČKI STATO DA MAR

Stato da Mar bio je politički arhipelag gradova, otoka i jurisdikcija rasprostranjenih od Jadrana do istočnog Sredozemlja. Povezivala ga je mreža trgovačkih ruta i luka, utvrđenih naselja i velikih utvrda, preko kojih je Venecija štitila plovidbu i širila svoju vlast prema Levantu. Ta se vlast oblikovala i kroz sporazume s lokalnim zajednicama i elitama, koje su zadržale vlastite statute i običaje.







XV sec. / 15. st.

Venezia consolida la propria presenza lungo la costa della dalmazia, rafforzando città portuali e rotte adriatiche.

Venecija učvršćuje svoju prisutnost duž dalmatinske obale, jačajući lučke gradove i jadranske rute.

XVI sec. / 16. st.

Le guerre veneto-ottomane del XV secolo riducono il dominio veneziano nel Mediterraneo orientale

Mletačko-osmanski ratovi 15. stoljeća smanjuju mletačku vlast u istočnom Sredozemlju; Trogir je opustošen.

Početkom 16. stoljeća Osmansko Carstvo ponovno prijeti područjima Dalmacije s istoka.

Agli inizi del XVI l'Impero Ottomano minaccia nuovamenteil territori della Dalmazia da oriente.

Cresce l'esigenza di rafforzare le difese urbane e creare nuovi presidi fortificati.

Raste potreba za jačanjem gradskih obrana i stvaranjem novih utvrđenih uporišta.

XVII sec. / 17. st.

Le due Guerre di Morea (1684-1699, 1714-1719), videro il passaggio della giurisdizione del Peloponneso dai veneziani ai turchi.

Nel 1571, a Lepanto, Venezia arresta temporaneamente l'espansione ottomana.

Godine 1571., kod Lepanta, Venecija privremeno zaustavlja osmansko širenje na Sredozemlju.

Dva Morejska rata (1684.–1699., 1714.–1719.) obilježila su prijelaz jurisdikcije nad Peloponezom s Mlečana na Osmanlije.

XVIII sec. / 18.st.

A fine del XVIII secolo, il Trattato di Campoformio sancisce la fine della Repubblica di Venezia.

Krajem 18. stoljeća Ugovor iz Campoformija označava kraj Mletačke Republike.

Finisce il dominio veneziano, ma città, porti e fortificazioni ne conservano ancora oggi l'eredità. Mletačka vlast završava, ali gradovi, luke i utvrde još i danas čuvaju njezinu baštinu.

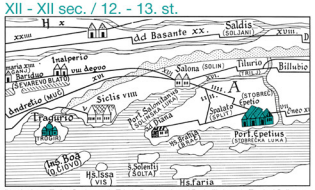
LA DALMAZIA VENEZIANA

La Dalmazia veneziana era organizzata attorno a una successione di grandi centri costieri, tra cui Spalato (*Split*), Traù (*Trogir*), Sebenico (*Šibenik*) e Zara (*Zadar*), che concentravano funzioni amministrative, commerciali e militari. Tra questi centri si estendeva un territorio articolato in borghi, campagne e approdi, nel quale il controllo della costa si intrecciava con quello delle vie verso l'entroterra.

MLETAČKA DALMACIJA

Mletačka Dalmacija bila je organizirana oko niza velikih obalnih središta, među kojima su Split, Trogir, Šibenik i Zadar, koja su objedinjavala upravne, trgovačke i vojne funkcije. Između tih središta prostirao se teritorij sastavljen od naselja, ruralnih područja i pristaništa, u kojem se nadzor nad obalom ispreplitao s kontrolom putova prema zaleđu.

XII - XII sec. / 12. - 13. st.



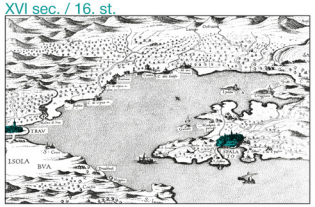
Il territorio tra Traù e Spalato nella Tabula Peutingeriana / *Područje između Trogira i Splita na Peutingerovoj karti*
Fonte / *Izvor:* I. Babić, Prostor između Trogira i Splita: kulturnohistorijska studija, 1984, p. 46.

ca. 1530 / oko 1530.

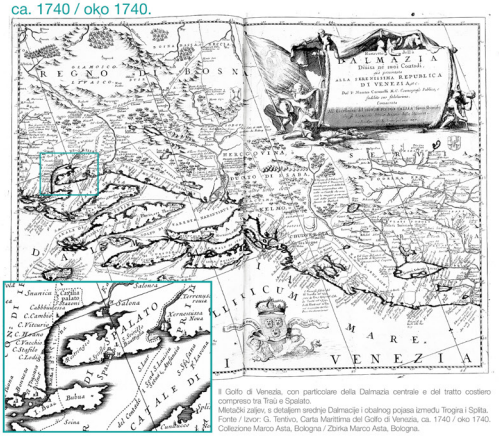


Il territorio della Dalmazia centrale nelle cartografie del XVI secolo / *Područje srednje Dalmacije na kartama 16. stoljeća*
Fonti / *Izvori:*
1. Martino Rota, rappresentazione del territorio fra Traù e Spalato, seconda metà del XVI secolo / *Martin Kolunić Rota, prikaz područja između Trogira i Splita, druga polovica 16. st.;*
2. Particolare della carta Tuto el contado di Zara e Sebenicho, autore anonimo, stampata da Matteo Pagano, Venezia, ca. 1530 / *Detalj karte Cijeli okrug Zadra i Šibenika, nepoznati autor, tiskê Matteo Pagano, Venecija, oko 1530.*

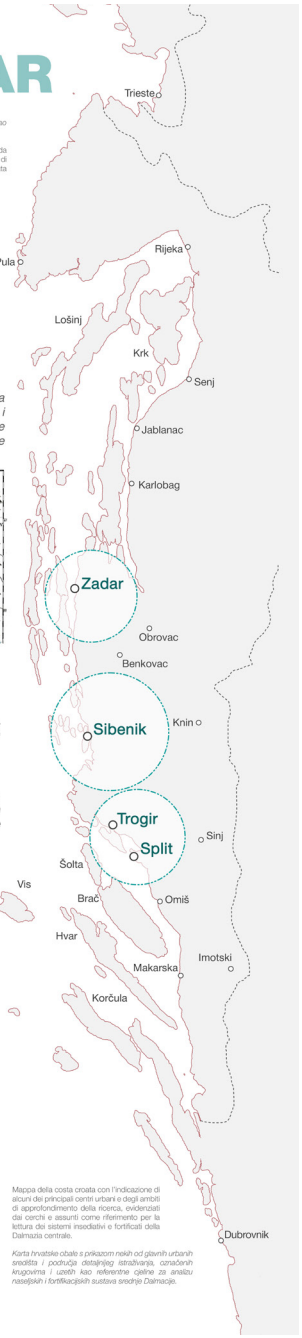
XVI sec. / 16. st.



ca. 1740 / oko 1740.



Il Golfo di Venezia, con particolare della Dalmazia centrale e del tratto costiero compreso tra Traù e Spalato.
Mletački zaljev, s detaljem srednje Dalmacije i obalnog pojasa između Trogira i Splita.
Fonte / *Izvor:* G. Tentivo, Carta Marittima del Golfo di Venezia, ca. 1740 / oko 1740. Collezione Marco Asta, Bologna / *Zbirka* Marco Asta, Bologna.



Mappa della costa croata con l'indicazione di alcuni dei principali centri urbani e degli ambiti di approfondimento della ricerca, evidenziati dai cerchi e assunti come riferimento per la lettura dei sistemi insediativi e fortificati della Dalmazia centrale.

Karta hrvatske obale s prikazom nekih od glavnih urbanih središta i područja detaljnijeg istraživanja, označenih krugovima i uzetih kao referentne cjeline za analizu naseljskih i fortifikacijskih sustava srednje Dalmacije.

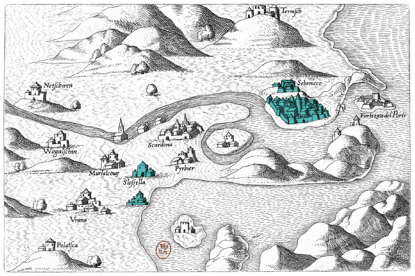
I KAŠTEL DELLA DALMAZIA CENTRALE
KAŠTELI SREDNJE DALMACIJE

INSEDIAMENTI DIFENSIVI E POTERI LOCALI

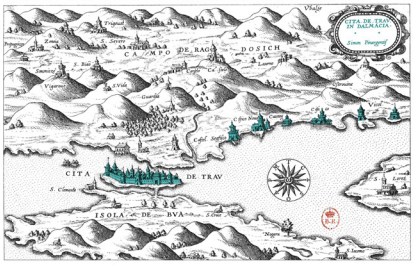
Tra XV e XVI secolo, l'avanzata ottomana trasformò la costa dalmata in un territorio di frontiera, esposto a continue incursioni. La difesa non poteva dipendere soltanto dai grandi centri e dalle principali fortezze. La Serenissima autorizzò quindi famiglie nobili, proprietari terrieri ed enti ecclesiastici a costruire, spesso a proprie spese, torri, castelli, residenze fortificate e piccoli nuclei protetti. Questi presidi offrivano rifugio agli abitanti dei villaggi dell'entroterra, garantivano la continuità del lavoro agricolo e contribuivano al controllo della costa e delle vie di collegamento. Intorno alle fortificazioni sorsero comunità organizzate, dotate di proprie forme di difesa e legate ai signori locali da rapporti economici e giurisdizionali. Nacque così una rete diffusa di insediamenti nella quale l'autorità veneziana non sostituiva i poteri locali, ma ne indirizzava e coordinava le risorse all'interno di un più ampio sistema politico e militare.

OBRAMBENA NASELJA I LOKALNI GOSPODARI

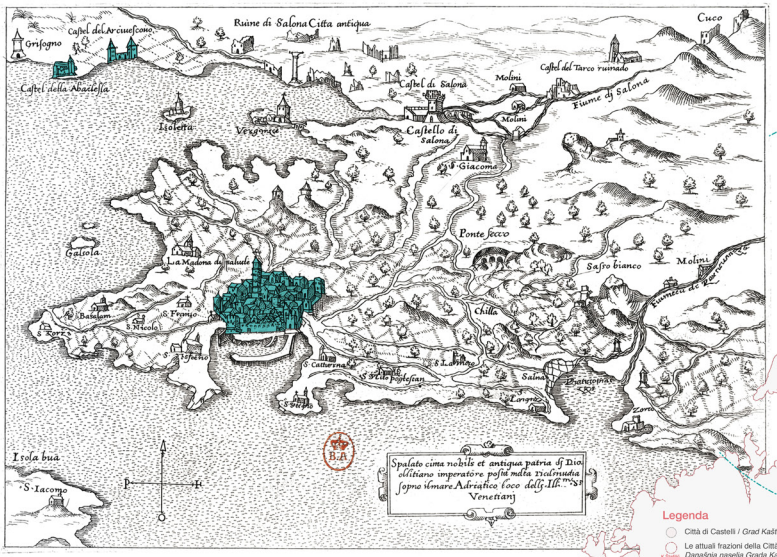
Između 15. i 16. stoljeća osmansko napredovanje pretvorilo je dalmatinsku obalu u pogranično područje izloženo stalnim upadima. Obrana se nije mogla oslanjati samo na velika središta i glavne utvrde. Serenissima je stoga dopustila plemićkim obiteljima, zemljoposjednicima i crkvenim ustanovama da, često o vlastitom trošku, grade kule, kaštele, utvrđene rezidencije i manje zaštićene naseobine. Ta su uporišta pružala utočište stanovnicima sela u zaledu, omogućavala kontinuitet poljoprivredne proizvodnje te pridonosila nadzoru obale i komunikacijskih pravaca. Oko utvrda nastajale su organizirane zajednice s vlastitim oblicima obrane, povezane s lokalnim gospodarima gospodarskim i jurisdikcijskim odnosima. Tako je nastala razgranata mreža naselja u kojoj mletačka vlast nije zamjenjivala lokalne strukture moći, nego je njihove resurse usmjeravala i koordinirala unutar širega političkog i vojnog sustava.



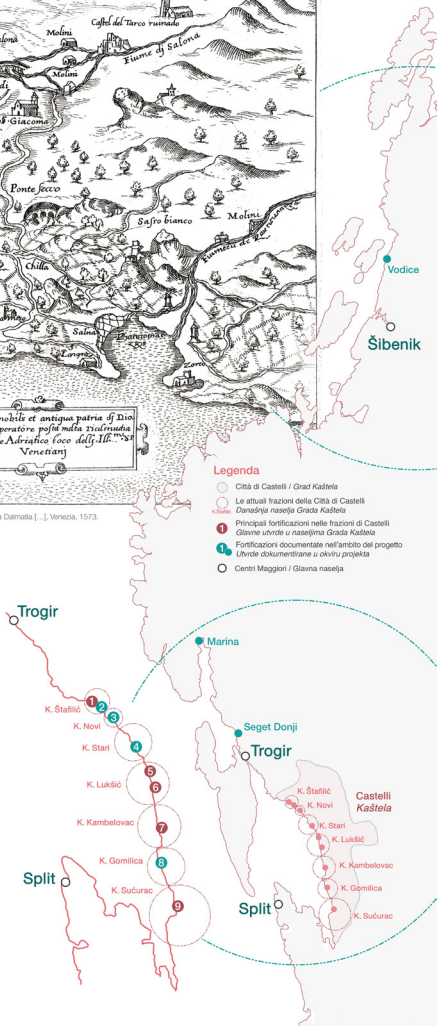
Sebenico e il suo territorio / *Šibenik i okolica.* Rielaborazione da / *Preradа prema:* S. Pinargenti, Isole [...], 1573.



Traù e l'Isola di Bua / *Trogir i otok Čiovo.* Rielaborazione grafica da / *Grafička prerada prema:* S. Pinargenti, Isole [...], 1573.



Spalato e il territorio di Salona / *Split i područje Salone.* Rielaborazione da / *Prerada prema:* S. Pinargenti, Isole che son da Venetia nella Dalmatia [...], Venezia, 1573.

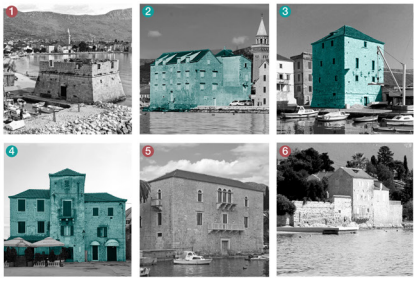


GLI ESEMPI FRA TRAÙ E SPALATO

Nella fascia compresa tra la catena del Kozjak e il mare, ripartita tra le giurisdizioni di Traù e Spalato, si sviluppò una fitta sequenza di insediamenti fortificati. Dalla fine del XV secolo, infatti, il baricentro dell'abitato si spostò progressivamente verso la costa, dove alle residenze fortificate si affiancarono nuclei racchiusi da mura. Nel tempo, questi primi complessi si ampliarono oltre le cinte originarie, dando forma a una sequenza di centri distinti ma strettamente legati al mare e al paesaggio agricolo retrostante. Nel lessico locale, kaštel indicava la residenza fortificata e, per estensione, l'abitato sorto intorno, come testimoniano ancora oggi i nomi dei centri di Kaštela.

PRIMJERI IZMEĐU TROGIRA I SPLITA

Na području između planine Kozjak i mora, podijeljenom između jurisdikcija Trogira i Splita, razvio se gust niz utvrđenih naselja. Od kraja 15. stoljeća težište naseljavanja postupno se premještalo prema obali, gdje su se uz utvrđene rezidencije razvijale jezgre opasane zidinama. S vremenom su se ti prvi kompleksi proširili izvan izvornih obrambenih perimetara, oblikujući niz zasebnih središta snažno povezanih s morem i poljoprivrednim krajolikom u zaleđu. U lokalnom je nazivlju kaštel označavao utvrđenu rezidenciju, a zatim i naselje koje se oko nje razvilo, o čemu i danas svjedoče nazivi naselja Kaštela.





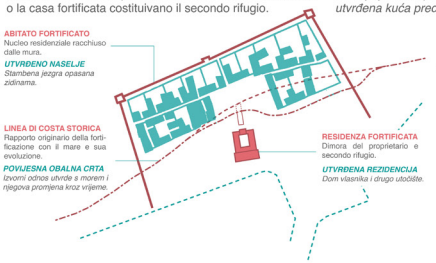
Castelli raffigurati e odierne frazioni della Città di Castelli
1. Castel Nehaj (torre Lodi), a Castel Stafilico; 2. Castel Stafilico; 3. Castel Cippico, a Castelnuovo; 4. Castel Cippico, a Castelvecchio; 5. Castel Vitturi, a Castel Lukšić; 6. Castel Rosani, a Castel Lukšić; 7. Castel Cambio, a Castel Kambelovac; 8. Castel Abbadessa, a Castel Gomilica; 9. Castel San Giorgio, a Castel Sućurac.

Prikazani kaštели i današnja naselja Grada Kaštela
1. Kaštel Nehaj (kula Lodi), u Kaštelu Štafilicu; 2. Kaštel Štafilić; 3. Novi kaštel Čipiko, u Kaštelu Novi; 4. Stari kaštel Čipiko, u Kaštelu Stari; 5. Kaštel Vitturi, u Kaštelu Lukšiću; 6. Kaštel Rušinac, u Kaštelu Lukšiću; 7. Kaštel Cambi, u Kaštelu Kambelovcu; 8. Opatčin kaštel (Kaštilac), u Kaštelu Gomilici; 9. Kaštel sv. Jurja, u Kaštelu Sućuru.

I KAŠTEL COME MODELLO INSEDIATIVO
KAŠTELI KAO NASEOBINSKI MODEL

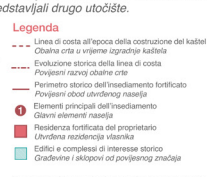
TIPOLOGIE E MODELLI

Pur con forme diverse, gli insediamenti fortificati seguivano uno schema ricorrente: alla residenza del proprietario, posta verso il mare, si affiancava un abitato racchiuso da mura. L'abitato era la prima linea di difesa; il kaštel, la torre o la casa fortificata costituivano il secondo rifugio.



TIPOLOGIJE I MODELI

Unatoč različitim oblicima, utvrđena su naselja slijedila ponavljajući obrazac: uz rezidenciju vlasnika, smještenu prema moru, razvijalo se naselje opasano zidinama. Naselje je činilo prvu liniju obrane, dok su kaštel, kula ili utvrđena kuća predstavljali drugo utočište.



La sovrapposizione tra impianto storico e assetto attuale rende leggibili le permanenze del tessuto originario e le trasformazioni che ne hanno progressivamente modificato forma ed estensione.

Preklapanje povijesne strukture i današnjeg stanja omogućuje prepoznavanje očuvanih elemenata izvornog tkiva i promjena koje su postupno mijenjale oblik i opseg naselja.



IL MODELLO NELLA BAIA DEI CASTELLI

Il confronto planimetrico tra gli insediamenti della baia rende leggibili le invarianti del sistema e le sue variazioni. La posizione della residenza fortificata, l'andamento delle mura e il rapporto con la costa mutano da un centro all'altro, adattandosi alla morfologia del luogo. Ne emerge uno schema comune, declinato però secondo condizioni locali differenti. La ricostruzione della costa storica mostra inoltre come molte fortificazioni sorgessero direttamente sul mare, un rapporto oggi spesso alterato dalle trasformazioni del litorale. Le planimetrie sono restituite alla stessa scala di rappresentazione.

MODEL KAŠTELA IZMEĐU TROGIRA I SPLITA

Usporedba tlocrta naselja u zaljevu omogućuje prepoznavanje zajedničkih obilježja sustava i njegovih varijacija. Položaj utvrđene rezidencije, pružanje zidina i odnos prema obali razlikuju se od jednog naselja do drugoga, prilagođavajući se morfologiji mjesta. Tako se prepoznaje zajednički obrazac, oblikovan prema različitim lokalnim uvjetima. Rekonstrukcija povijesne obalne crte pokazuje i kako su mnoge utvrde izvorno bile podignute neposredno uz more, dok je taj odnos danas često izmijenjen preobrazbama obale. Tlocrti su prikazani u istom mjerilu.

KAŠTEL NEHAJ



KAŠTEL ŠTAFILIĆ



KAŠTEL NOVI



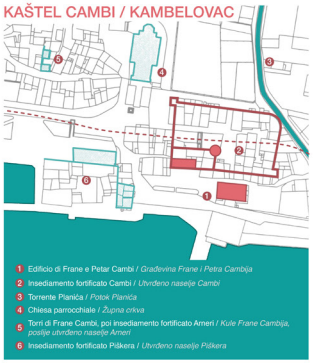
KAŠTEL RUŠINAC



KAŠTEL VITTURI / LUKŠIĆ



KAŠTEL CAMBI / KAMBELOVAC



KAŠTEL GOMILICA



KAŠTEL SUĆURAC



Le planimetrie riportate sono rielaborazioni grafiche da / *Prikazani tlocrti grafičke su prerade prema:* K. Marasović, Kaštelanski kašteli, Kaštela: Muzej grada Kaštela; Split: Sveučilište u Splitu, Fakultet gradevinarstva, arhitekture i geodezije, 2025.

VARIAZIONI E CARATTERI ARCHITETTONICI
VARIJACIJE I ARHITEKTONSKA OBILJEŽJA

IL MODELLO OLTRE LA BAIA DEI CASTELLI

Il sistema dei castelli non rimase circoscritto alla baia tra Traù e Spalato. A ovest di Traù, Marina e Seghetto riproposero tra XV e XVI secolo il modello dell'insediamento fortificato costiero. Lungo le coste di Sebenico e Zara sorsero nuclei analoghi, con o senza una fortificazione del proprietario, organizzati secondo differenti schemi. A Vodice, l'abitato era protetto verso terra da mura, torri angolari e fossato, mentre la chiesa parrocchiale trovava posto all'interno del recinto. Il confronto mostra così la diffusione e le diverse declinazioni di uno stesso principio difensivo lungo la costa dalmata.

MODEL IZVAN KAŠTELANSKOG ZALJEVA

Sustav kaštela nije ostao ograničen na zaljev između Trogira i Splita. Zapadno od Trogira, Marina i Seget tijekom 15. i 16. stoljeća ponavljaju model obalnog utvrđenog naselja. Duž šibenske i zadarske obale nastajala su slična naselja, s utvrdom vlasnika ili bez nje, organizirana prema različitim prostornim shemama. U Vodicama je naselje prema kopnu bilo zaštićeno zidinama, kutnim kulama i jarkom, dok se župna crkva nalazila unutar obrambenog perimetra. Usporedba tako pokazuje širenje i različite varijante istoga obrambenog načela duž dalmatinske obale.

SEGET DONJI



MARINA



VODICE



Legenda

- Linea di costa presunta all'epoca della costruzione / *Pretpostavljena obalna linija u vrijeme izgradnje*
- Perimetro storico dell'insediamento fortificato / *Povijesni obod utvrđenog naselja*
- Elementi principali dell'insediamento / *Glavni elementi naselja*
- Fortificazione del proprietario / *Utvrda posjednika*
- Edifici e complessi di interesse storico / *Građevine i sklopovi od povijesnog značaja*

UN LESSICO ARCHITETTONICO COMUNE

Alla scala architettonica, le fortificazioni dei proprietari assumono forme differenti, riconducibili a più tipologie. Il confronto proposto si concentra sulle residenze fortificate e sulle torri, documentati nell'ambito del progetto. Nei primi, la residenza si associa a una corte fortificata; nelle seconde, funzioni abitative e difensive si sovrappongono in altezza. Pur con configurazioni diverse, entrambe condividono un repertorio di accessi, merlature, feritoie e altri dispositivi di difesa. Il confronto mette così in luce un linguaggio architettonico comune tra i casi documentati.

TORRI

Le torri erano edifici autonomi a pianta quadrata o rettangolare, sviluppati generalmente su tre o quattro livelli e destinati tanto alla difesa quanto alla residenza. Il loro carattere fortificato era affidato a pochi ma riconoscibili elementi: il basamento a scarpa, talvolta sottolineato da un toro, le feritoie e le aperture per il tiro, fino agli apparati sommitali con caditoie e coronamenti difensivi.

KULE

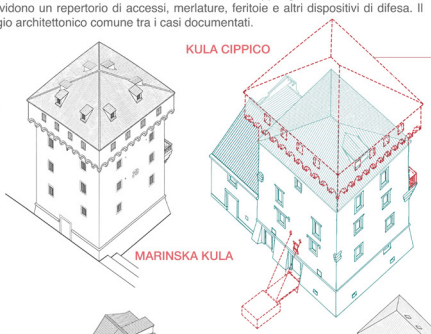
Kule su bile samostalne građevine kvadratnog ili pravokutnog tlocrta, najčešće razvijene na tri ili četiri etaže te namijenjene obrani i stanovanju. Njihov utvrđeni karakter određivao je niz prepoznatljivih elemenata: skošeno podnožje, ponekad naglašeno kamenim torusom, strijelnice i otvori za gađanje te gornji obrambeni sklopovi s maškulima i obrambenim kruništima.

RESIDENZA FORTIFICATA

Nella residenza fortificata il carattere difensivo investiva l'intero complesso: alla residenza rivolta verso il mare si contrapponeva una corte protetta da mura e torri. Le cinte erano concluse da merlature e cammini di ronda lignei e aperte da feritoie e bocche da fuoco; torri angolari o mediane consentivano il tiro fiancheggiante. Nei casi documentati, questi caratteri restano solo in parte leggibili a causa dei successivi rimaneggiamenti.

UTVRĐENA REZIDENCIJA

Cijela rezidencija je imala je obrambeni karakter: nasuprot rezidenciji okrenutoj prema moru nalazilo se dvorište zaštićeno zidinama i kulama. Zidine su bile završene kruništima i drvenim obrambenim ophodima te otvorene strijelnicama i otvorima za vatreno oružje; kutne ili središnje kule omogućavale su bočnu obranu. U dokumentiranim primjerima ti su elementi danas samo djelomično čitljivi zbog kasnijih preinaka.





ZAJEDNIČKI LEKSIK ARHITEKTURE

Na arhitektonskoj razini, utvrde posjednika poprimaju različite oblike, svrstive u više tipologija. Predložena usporedba usredotočuje se na utvrđene rezidencije i kule, dokumentirane u okviru projekta. Kod prvih je rezidencija povezana s utvrđenim dvorištem, dok se kod drugih stambene i obrambene funkcije preklapaju po visini. Unatoč različitim konfiguracijama, obje skupine dijele repertoar ulaza, kruništa, strijelnica i drugih obrambenih elemenata. Usporedba tako ističe zajednički arhitektonski jezik dokumentiranih primjera.

LE BERTESCHE

La bertesca è una struttura difensiva aggettante, posta alla sommità delle mura, con aperture inferiori per colpire gli assalitori. Nei Kaštel se ne conservano rari esempi ancora completi del rivestimento esterno.

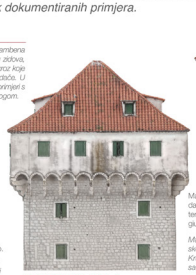
MAŠIKUL

Mašikul je istaknuta obrambena struktura smještena pri vrhu zidova, s otvorima u donjem dijelu kroz koje se mogla djelovati na napadače. U kaštelima su sačuvani rijetki primjeri s još očuvanom vanjskom oblogom.



Confronto con la Torre di Marina per la ricostruzione di torre Cippico. *Usporedba s Marinskom kulom za rekonstrukciju Kule Cippico.*

Rielaborazione da / *Prerada prema:* K. Marasović, *Kaštelanski kaštel*, 2025.



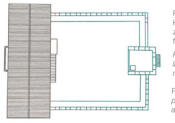
MARINSKA KULA



KAŠTEL GOMILICA

Marina appartiene al tipo delle grandi torri quadrangolari, caratterizzate dal basamento a scarpa e da apparati difensivi sommitali coronamento terminava con una bertesca; un dispositivo analogo, tra i rari esempi giunti fino a noi ancora conservati, è visibile nel Kaštilac di Kaštel Gomilica.

Marina pripada tipu velikih četverokutnih kula, karakteriziranih skošenim podnožjem i obrambenim elementima u gornjoj zoni. Krunište je bilo zaštićeno maškulima: sličan uređaj, među rijetkim još sačuvanim primjerima, vidljiv je na Kaštilcu u Kaštel Gomilici.



Planimetria ricostruttiva del Kaštel Stafilico, con il palazzo verso il mare e la corte fortificata.

Rekonstrukcijski tlocrt Kaštela Stafilico, s palačom prema moru i utvrđenim dvorištem.

Rielaborazione da / *Prerada prema:* K. Marasović, *Kaštelanski kaštel*, 2025.

LA CINTA MERLATA

Le corti dei kaštel erano protette da alte mura concluse da un coronamento merlato e da un cammino di ronda ligneo. Feritoie e aperture per le armi da fuoco permettevano di controllare lo spazio esterno, mentre le torri disposte agli angoli o lungo il fronte garantivano la difesa fiancheggiante.

ZIDINE S KRUNIŠTEM

Dvorišta kaštela bila su zaštićena visokim zidinama završenima kruništem s merlonima i drvenim obrambenim ophodom. Strijelnice i otvori za vatreno oružje omogućavali su nadzor vanjskog prostora, dok su kule smještene na uglovima ili duž pročelja osiguravale bočnu obranu.

KAŠTEL ŠTAFILIĆ



I KAŠTEL NELLA CITTÀ CONTEMPORANEA
KAŠTELI U SUVREMENOM GRADU





PERMANENZE E TRASFORMAZIONI DEL TESSUTO STORICO

Con il venir meno della funzione difensiva, i nuclei fortificati iniziarono a espandersi oltre le cinte originarie. L'avanzamento della linea di costa, dovuto all'urbanizzazione e alla cementificazione del litorale, modificò in molti casi il rapporto diretto dei kaštel con il mare, mentre la crescita edilizia dei secoli successivi saldò gradualmente i centri in un tessuto urbano continuo. Oggi torri, palazzi e tratti di mura sopravvivono tra costruzioni più recenti, ampliamenti e spazi profondamente trasformati. La lettura dei kaštel richiede quindi di ricostruire le relazioni originarie tra fortificazione, abitato e linea di costa, spesso divenute difficili da riconoscere nella città contemporanea.

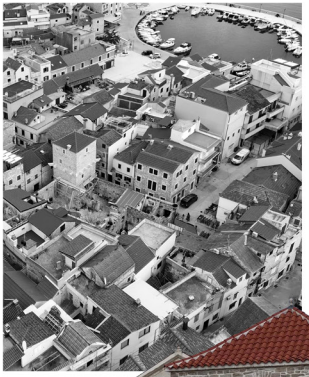
KONTINUITET I PREOBRAZBE POVIJESNOG TKIVA

Nestankom obrambene funkcije utvrđene su se jezgre počele širiti izvan izvornih zidina. Pomicanje obalne crte, uzrokovano urbanizacijom i betonizacijom obale, u mnogim je slučajevima promijenilo neposredan odnos kaštela s morem, dok je izgradnja tijekom sljedećih stoljeća postupno povezala naselja u kontinuirano urbano tkivo. Danas kule, palače i dijelovi zidina opstaju među novijim građevinama, dogradnjama i snažno preobraženim prostorima. Razumijevanje kaštela stoga zahtijeva rekonstrukciju izvornih odnosa između utvrde, naselja i obalne crte, koji su u suvremenom gradu često teško prepoznatljivi.



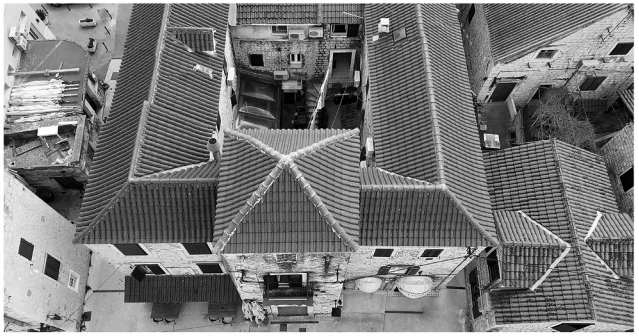






L'espansione urbana ha occupato gli spazi attorno alle fortificazioni, modificando la percezione dei prospetti, i rapporti di scala e riducendo le distanze che consentivano una lettura unitaria dei kaštel.

Urbano širenje zauzelo je prostore oko utvrda, mijenjajući percepciju pročelja i odnose mjerila te smanjujući udaljenosti koje su omogućavale cjelovito sagledavanje kaštela.



La trasformazione riguarda in modo altrettanto evidente gli spazi aperti che organizzavano il sistema insediativo. L'espansione edilizia e il progressivo avanzamento della linea di costa hanno modificato queste relazioni, occupando aree un tempo libere, interrompendo visuali e cancellando separazioni essenziali alla percezione delle fortificazioni. Anche accessi, percorsi e affacci hanno perso parte del loro significato originario, mentre gli edifici storici sono stati progressivamente assorbiti dal tessuto urbano. Il kaštel sopravvive così come testimonianza materiale di un sistema spaziale oggi frammentato.

Preobrazba se jednako jasno očituje i u otvorenim prostorima koji su organizirali prostorni sustav naselja. Širenje izgradnje i postupno pomicanje obalne crte izmijenili su te odnose, zauzimajući nekada slobodne površine, prekidajući vizure i uklanjajući prostorne razmake važne za percepciju utvrda. Pristupi, putovi i pogledi također su izgubili dio svojega izvornog značenja, dok su povijesne građevine postupno apsorbirane u urbano tkivo. Kaštel tako opstaje kao materijalno svjedočanstvo danas fragmentiranoga prostornog sustava.



I KAŠTEL TRA ABITARE E TUTELA
KAŠTELI ZA STANOVANJE I ZAŠTITU



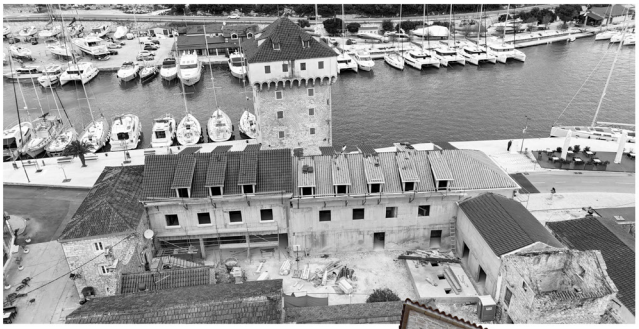


USI CONTEMPORANEI, TRASFORMAZIONI E RESTAURI

Oltre alle trasformazioni che interessano i centri storici, anche gli stessi kaštel sono oggi oggetto di interventi di consolidamento, restauro, ricostruzione e cambio d'uso. Dopo la perdita della funzione difensiva, queste architetture hanno continuato a essere abitate, adattate e trasformate, accumulando nel tempo modifiche e nuove configurazioni. Gli interventi contemporanei rispondono a nuove esigenze di sicurezza, accessibilità e utilizzo degli spazi, modificando strutture e configurazioni sedimentate nel tempo.

SUVREMENE NAMJENE, PREOBRAZBE I OBNOVA

Osim preobrazbi koje zahvaćaju povijesne jezgre, i sami su kašteli danas predmet zahvata konsolidacije, obnove, rekonstrukcije i promjene namjene. Nakon gubitka obrambene funkcije ove su se građevine nastavile koristiti, prilagođavati i mijenjati, postupno akumulirajući nove preinake i konfiguracije. Suvremeni zahvati odgovaraju zahtjevima sigurnosti, pristupačnosti i korištenja prostora, intervenirajući na već snažno stratificiranim strukturama. Gradilište tako postaje nova faza u povijesti građevina koje se nastavljaju mijenjati zajedno s naseljima u kojima se nalaze.



A Marina e Vodice i cantieri recenti mostrano la continua trasformazione delle fortificazioni storiche. Alla Citadela di Marina la rifunzionalizzazione ha comportato interventi rilevanti sulle strutture murarie; a Vodice la Torre Čorić, oggi privata, è interessata da lavori di adattamento dell'edificio e degli spazi adiacenti.

U Marini i Vodicama noviji radovi pokazuju stalnu preobrazbu povijesnih utvrda. Na Citadeli u Marini prenamjena je uključila značajne zahvate na zidanim strukturama, dok se na kuli Čorić u Vodicama, danas u privatnom vlasništvu, izvode radovi prilagodbe građevine i susjednih prostora.







A Castelnuovo, la Torre Cippico e gli edifici adiacenti sono stati interessati da interventi di rifunzionalizzazione. Un precedente progetto comportò la sopraelevazione della torre, poi rimossa; oggi il complesso è nuovamente oggetto di lavori.

U Kaštel Novom kula Cippico i susjedne građevine prošle su kroz zahvate prenamjene. Ranji projekt uključivao je nadogradnju kule, poslije uklonjenu; danas se izvode novi radovi.



A Marina, nelle strutture della cittadella già profondamente rimaneggiate in epoca recente, è in corso la realizzazione di una struttura alberghiera.

U Marini je u strukturama citadele, već znatno preoblikovanima u novije vrijeme, u tijeku izgradnja hotelskog objekta.



I SITI ATTRAVERSO IL RILIEVO DIGITALE
ISTRAŽENI PRIMJERI I DIGITALNA IZMJERA

SEGET DONJI







MARINA









KAŠTEL NOVI



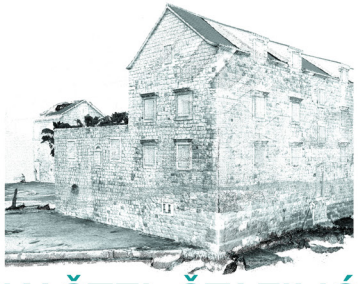


VODICE

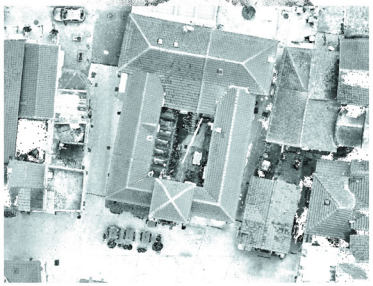




KAŠTEL GOMILICA









KAŠTEL ŠTAFILIĆ

KAŠTEL STARI

ATLANTE DEI SITI
ATLAS MJESTA





BORGHI NASELJA

IT

Tra XV e XVII secolo, lungo la costa dalmata sorsero numerosi borghi fortificati destinati a offrire protezione stabile alle comunità esposte alle incursioni. Le mura definivano un nucleo compatto, articolato da abitazioni, percorsi e spazi comuni e protetto da torri e accessi controllati. La forma dell'abitato variava in rapporto al sito e alla presenza della fortificazione del proprietario. Seghetto (Seget Donji) conserva con particolare chiarezza questo impianto: un nucleo compatto, cinto da mura e torri angolari, organizzato attorno a uno spazio centrale e successivamente ampliato oltre il recinto originario.

HR

Između 15. i 17. stoljeća duž dalmatinske obale nastajala su brojna utvrđena naselja namijenjena trajnoj zaštiti zajednica izloženih napadima. Zidine su određivale zbijenu jezgru sastavljenu od kuća, putova i zajedničkih prostora, zaštićenu kulama i nadziranim ulazima. Oblik naselja mijenjao se ovisno o položaju i prisutnosti utvrde vlasnika. Seghetto (Seget Donji) osobito jasno čuva takvu strukturu: zbijenu jezgru opasanu zidinama i ugaonim kulama, organiziranu oko središnjeg prostora i poslije proširenu izvan izvornog obrambenog perimetra.





CASTELLI KAŠTELI

IT

Affacciati sul mare o fondati su scogli poco distanti dalla riva, i kaštel riunivano residenza signorile e difesa all'interno di complessi articolati attorno a corti fortificate. Accanto ad essi si svilupparono abitati protetti da mura, organizzati secondo configurazioni diverse in rapporto alla costa e alla morfologia del luogo. Il Kaštilac di Castel Abbadessa (Kaštel Gomilica), Castel Cippico presso Castelvecchio e Castel Stafileo mostrano differenti declinazioni di questo modello. Con la perdita della funzione militare, fortificazioni e abitati continuarono a trasformarsi, mantenendo un ruolo determinante nella struttura dei centri costieri contemporanei.

HR

Smješteni uz more ili podignuti na hridima nedaleko od obale, kaštели su objedinjavali vlastelinsku rezidenciju i obrambenu funkciju unutar sklopova organiziranih oko utvrđenih dvorišta. Uz njih su se razvijala naselja zaštićena zidinama, oblikovana na različite načine u odnosu na obalu i morfologiju mjesta. Kaštilac u Kaštel Gomilici, dvorac Cippico kod Kaštel Starog i dvorac Štafileo pokazuju različite varijante ovoga modela. Gubitkom vojne funkcije utvrde i naselja nastavili su se preobražavati, zadržavajući važnu ulogu u strukturi suvremenih obalnih središta.





TORRI KULE

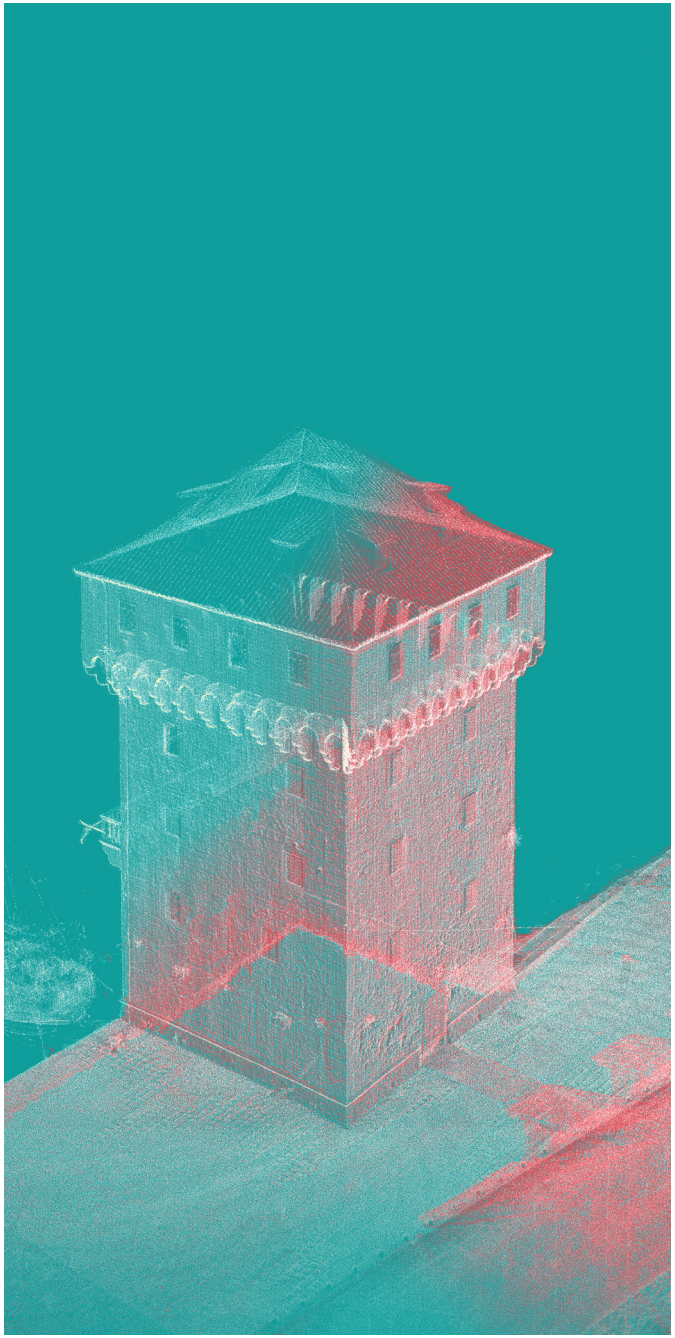
IT

Lungo la costa dalmata, la torre rappresenta una delle forme ricorrenti della fortificazione signorile. Nella torre, funzioni difensive e residenziali si sovrappongono verticalmente all'interno dello stesso edificio. A differenza del kaštel, articolato tra residenza e corte fortificata, la torre concentra quindi in un unico organismo le diverse esigenze dell'abitare e della difesa. Gli esempi di Marina, Vodice e Kaštel Novi mostrano diverse relazioni tra torre, abitato e costruzioni circostanti. Basamenti a scarpa, accessi protetti, feritoie, caditoie e apparati sommitali ne definiscono il carattere fortificato, mentre gli spazi interni erano organizzati per accogliere insieme funzioni abitative e difensive.

HR

Duž dalmatinske obale kula predstavlja jedan od čestih oblika vlasteliske fortifikacije. U kuli se obrambene i stambene funkcije vertikalno preklapaju unutar iste građevine. Za razliku od kaštela, organiziranog između rezidencije i utvrđenog dvorišta, kula u jednom sklopu objedinjuje različite potrebe stanovanja i obrane. Primjeri Marine, Vodica i Kaštel Novog pokazuju različite odnose između kule, naselja i okolnih građevina. Skošena podnožja, zaštićeni ulazi, strijelnice, mašikuli i gornji obrambeni elementi određuju njezin utvrđeni karakter, dok su unutarnji prostori bili organizirani za istodobno stanovanje i obranu.

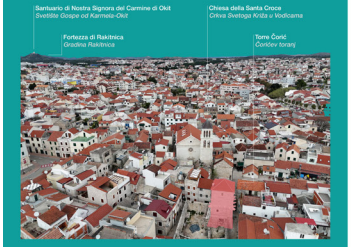




LA TORRE ČORIĆ A VODICE
KULA ĆORIĆ U VODICAMA



STORIA E TERRITORIO
POVIJEST I PROSTOR



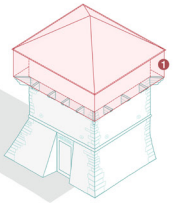
Vodice occupava una posizione strategica nel settore occidentale del distretto di Sebenico, legata soprattutto alla presenza di una sorgente d'acqua potabile presso la costa, fondamentale per il rifornimento della città nei mesi estivi. La sua protezione ricorre infatti nelle relazioni delle autorità veneziane, preoccupate che la forte potesse cadere sotto il controllo ottomano. La difesa dell'area si articolava tra la fortezza di Rakitnica, posta nell'entroterra, e la torre situata nel centro abitato, inserita in un sistema di protezione che comprendeva anche il perimetro fortificato del borgo. Con la caduta di Rakitnica nel 1571, la torre divenne il principale presidio di Vodice e assunse un ruolo ancora più rilevante. Nel 1646, all'inizio della guerra di Candia, fu coinvolta nell'unico attacco ottomano documentato contro il centro di Vodice, costituendo uno dei punti principali della sua difesa.

Vodice su zauzimale strateški položaj u zapadnom dijelu šibenskog distrikta, ponajprije zbog izvora pitke vode uz obalu, ključnog za opskrbu grada tijekom ljetnih mjeseci. Njegova se zaštita često spominje u izvješćima mletačkih vlasti, zabrinutih da bi izvori mogao pasti pod osmansku kontrolu. Obranja područja oslanjala se na utvrdu Rakitnica u zaleđu i na kulu smještenu u samom naselju, unutar sustava zaštite koji je obuhvaćao i utvrđeni perimetar naselja. Nakon pada Rakitnice 1571. godine kula je postala glavno obrambeno uporište Vodica i preuzela još važniju ulogu. Godine 1646., na početku Kandijskog rata, bila je uključena u jedini dokumentirani osmanski napad na središte Vodica, predstavljajući jedinu od glavnih točaka njegove obrane.

L'EVOLUZIONE DEL BORGO E DELLA TORRE
RAZVOJ NASELJA I KULE

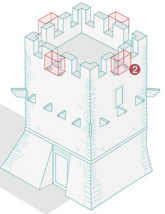


La costruzione della torre viene ricondotta al contratto stipulato nel 1533 tra il nobile Jeronim de Saraceinis e il tagliapietre Ivan di Hvar. La prima configurazione presentava un basamento a scarpa, aperture da fuoco e un coronamento aggettante su mensole, dotato di caditoie e protetto da un tetto a quattro falde. Resta incerto se, al momento della costruzione, sorgesse direttamente sull'acqua o già in rapporto con la terraferma.



1500

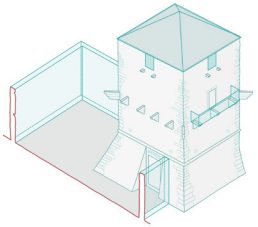
Gradnja kule povezuje se s ugovorom sklopljenim 1533. godine između plemića Jeronima de Saraceinisa i hvarskog klesara Ivana. Prvotna je konfiguracija imala skošeno podnožje, otvore za vatreno oružje i izbočeni završni dio na konzolama, s mašikulima i četverovrešnim krovom. Ostaje nejasno je li kula u vrijeme gradnje stajala neposredno u moru ili je već bila povezana s kopnom.



1600

Con la caduta della fortezza di Rakitnica, la torre resta l'unico caposaldo del distretto e viene sopraelevata in modo da rafforzarne le difese. Una nuova volta, orientata in senso ortogonale a quella sottostante, sorregge il nuovo livello, tagliando il lavabo e il camino rinascimentali del livello inferiore - dove prima si apriva la caditoia. La torre termina ora in un coronamento merlato, con una bertesca per lato, di cui restano oggi le sole mensole inferiori.

Padom utvrde Rakitnice, toranj ostaje jedino uporište distrikta te se nadograđuje kako bi se ojačala njegova obrana. Novi svod, okrenut okomito na onaj ispod njega, nosi novu razinu, presijecajući renesansni umivaonik i kamin donje razine — gdje se prije nalazio mašikul. Toranj sada završava zupčastim kruništem, s po jednom bertesom sa svake strane, od kojih danas ostaju samo donje konzole.



1800

Cessato il pericolo ottomano, la torre smette di essere un presidio militare e diventa dimora. I merli del coronamento vengono tamponati in favore della realizzazione di nuova copertura a falde; sui fronti rivolti verso il mare le posizioni delle bertesche, ormai inutili, diventano finestre, mentre la grande porta del balcone sul fronte sud-orientale viene chiusa e sostituita da una finestra. Sul lato sud-occidentale viene infine addossato un cortile recintato, già documentato nel catasto asburgico del 1825.

Nakon prestanka osmanske opasnosti, toranj prestaje biti vojno uporište i postaje dom. Zupci kruništa se zazidavaju u korist nove krovne konstrukcije na četiri vode; na pročeljima okrenutima prema moru položaje bertesa, sada nepotrebne, postaju prozori, dok se velika balkonska vrata na jugoistočnom pročelju zazidavaju i zamjenjuju prozorom. Uz jugozapadnu stranu naposljetku se pristanja ograđeno dvorište, već zabilježeno u habsburškom katastru iz 1825.



LE TRACCE MATERIALI
MATERIJALNI TRAGOVI



Il fronte sud-ovest della torre
Jugozapadno pročelje kule



Il fronte sud-est
Jugoistočno pročelje



Lo stemma gotico
Gotički grb

ARALDICA E FASI SOVRAPPOSTE

Sul fronte sud-est uno stemma gotico con torre merlata e iniziali H.S. è tradizionalmente associato a Jeronim de Saraceinis, sebbene l'attribuzione non sia certa. Gli interventi degli anni Ottanta aggiunsero repliche e nuove merlate in corrispondenza degli appoggi delle precedenti strutture aggettanti.

HERALDIKA I PREKLOPLJENE FAZE

Na jugoistočnom pročelju gotički grb s prikazom kruništem završene kule i inicijalima H.S. tradicionalno se povezuje s Jerolimom de Saraceinom, iako atribucija nije sigurna. Zahvaljena iz 1980-ih dodane su replike i nove konzole na mjestima oslonaca ranijih istaknutih elemenata.

EVOLUZIONE DEL CORONAMENTO MERLATO

Sui quattro prospetti della torre sono ancora oggi visibili le mensole che un tempo sostenevano le bertesche, e si legge la traccia dei merli del coronamento che le univa. Il coronamento fu poi tamponato per lasciare spazio a un tetto ligneo; solo più tardi, nel Settecento, quando la torre perse definitivamente la funzione militare, le bertesche furono rimosse e tre delle loro posizioni riaperte come finestre.



Le mensole a sostegno delle bertesche
Konzole koje su nosile bertese

RAZVOJ ZUPČASTOG KRUNIŠTA

Na sva četiri pročelja tornja i danas su vidljive konzole koje su nekad nosile bertese, a čita se i trag zubaca kruništa koje ih je povezivalo. Krunište je potom zazidano kako bi se otvorio prostor za dvoriš krov; tek kasnije, u 18. stoljeću, kada je toranj konačno izgubio vojnu funkciju, bertese su uklonjene, a tri njihove pozicije ponovno otvorene kao prozori.



I merli sul fronte sud-ovest
Zupci na jugozapadnom pročelju

2026

Dopo un uso come sala espositiva tra il 2012 e il 2015, la torre viene dichiarata inagibile ed entra in un lungo stato di abbandono, aggravato dal fallimento del tentativo di acquisizione da parte del Comune di Vodice nel 2016 e del progetto di restauro del 2021. Ad oggi, il recupero della torre e del cortile adiacente è seguito dalla proprietà Ćorić.

Nakon uporabe kao izložbeni prostor između 2012. i 2015., toranj je proglašen neupotrebljivim i ulazi u dugo razdoblje zapuštenosti, dodatno otežano neuspjelom pokušaju otkupa Grada Vodica 2016. i projekta sanacije iz 2021. Obnovu tornja i pripadajućeg dvorišta danas vodi obitelj Ćorić.

Relaborazione da nuvola di punti TLS+UAV, 2026

Obrada oblaka točaka TLS+UAV, 2026

Lo spaccato assonometrico, ricavato dalla relaborazione della nuvola di punti, restituisce le proporzioni e l'organizzazione degli spazi interni della Torre Ćorić. Sono chiaramente leggibili la successione dei livelli, i solai voltati e i rapporti tra gli ambienti sovrapposti.

Aksonometrijski presjek, izrađen preradom oblaka točaka, prikazuje proporcije i organizaciju unutarnjih prostora Ćorićeva tornja. Jasno su čitljivi slijed etaža, svodišne međukatne konstrukcije i odnosi između međusobno nadovezanih prostora.

CASTELNUOVO E LA TORRE CIPPICO
KAŠTEL NOVI I KULA CIPPICO



INQUADRAMENTO STORICO
POVIJESNI KONTEKST

Nel 1512 Paolo Antonio Cippico, nobile di Trau e nipote di Coriolano, ottenne il permesso di costruirsi una torre nel mare, sotto gli scogli, e attorno ad essa un recinto fortificato di 60 passi per lato, collegato alla terraferma da un ponte levatoio. Serviva a difendere lui e i suoi contadini dalle incursioni ottomane. La torre era in piedi nel 1517, quando i Turchi la assalirono per la prima volta; alle sue spalle intanto cresceva il villaggio, chiamato *Castel Novi* per distinguerlo dal castello che il nonno Coriolano aveva costruito poco più a est, il *Kaštel Stari*.

Godine 1512. Pavao Antun Cippico, trogirski plemić i unuk Koriolana, dobio je dopuštenje da u moru, pod hridima podno crkve svetog Petra, sagradi kulu, a oko nje utvrđeni zaklon od 60 koraka sa svake strane, povezan s kopnom pokretnim mostom.
Služila je da obrani njega i njegove težake od osmanskih provala. Kula je stajala 1517., kada su je Osmanlije prvi put napali. Iza nje je u međuvremenu nastao naselje, nazvano Kaštel Novi kako bi se razlikovalo od kaštela što ga je djed Koriolan bio sagradio nešto istočnije, Kaštel Stari.



Foto storiche da / *Povijesne fotografije iz:* K. Marasović, Kaštelanski kašteli, 2025, 436, 514.



Stato attuale 2026 / *Postojeće stanje, 2026.*

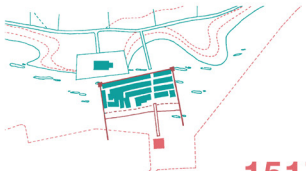
RAPPORTO CON IL TERRITORIO
ODNOS S TERITORIJEM



La torre nacque letteralmente in mezzo all'acqua, "sotto le ultime secche", a un centinaio di metri dalla riva di allora, che seguiva il tracciato dell'antica strada tra Salona e Trau. Sul pianoro alle sue spalle, rialzato di un paio di metri sul mare, c'era soltanto la vecchia chiesa di San Pietro. Isolata e raggiungibile solo dal ponte levatoio, la torre era il perno difensivo del villaggio, murato su tre lati e aperto a sud verso il mare. Nel Seicento, il braccio di mare che separava la torre dalla costa fu progressivamente colmato, saldando il complesso alla terraferma. Oggi la torre segna il fronte del porto e resta il punto di riconoscimento del profilo di Kaštel Novi visto dal mare.

Kula je dosljevno podignuta usred mora, „ispod posljednjih pličaka", stotinjak metara od tadašnje obale, koja je slijedila trasu antičke ceste između Salone i Trogira. Na zavoru iza nje, uzdignutu nekoliko metara iznad mora, nalazila se samo stara crkva sv. Petra, tvrđava i dostupna jedno poletnim mostom, kula je bila središnje obrambeno uporište naselja, opasanog zidinama s tri strane i otvorenog prema moru na jugu. Tijekom 17. stoljeća morske prolaz koji je odvajao kulu od obale postupno je nasut, čime je kompleks povezan s kopnom. Danas kula oblikuje pročelje luke i ostaje prepoznatljiva točka siluete Kaštel Novog gledane s mora.

L'INSEDIAMENTO NEL TEMPO
NASELJE KROZ VRIJEME



1517

La torre fu edificata tra il 1512 e il 1517, con fondazioni in mare realizzate dai maestri taurini Paviao Zudenić e Jakov Marković. Il quarto piano, aggettante su mensole, era dotato di caditoie; l'accesso avveniva tramite ponte levatoio, come mostrano ancora i fori per le catene sul fronte nord. Alle sue spalle si sviluppò il villaggio, protetto da mura su tre lati e organizzato da tre vie parallele. A nord, in asse con la strada principale, si apriva la porta ragguardevole attraverso un ponte con l'ultima campata levatoia.

Kula je podignuta između 1512. i 1517. godine, s temeljima u moru koje su izveli trogirski majstori Paviao Zudenić i Jakov Marković. Ćetveri kat, istaknut na konzolama, bio je opremljen mašikulima; pristup kuli odvijao se preko pokretnog mosta, o čemu i danas svjedoče otvori za lance na sjevernom pročelju. Iza kule razvilo se naselje, zaštićeno zidinama s tri strane i organizirano trima paralelnim ulicama. Na sjeveru, u osi glavne ulice, nalazila su se vrata do kojih se dolazilo mostom s pokretnim rasponom.



1831

Con il venir meno della minaccia ottomana, l'abitato si espanse oltre le mura, quasi raddoppiando la propria superficie. La Torre Cippico perse progressivamente la funzione militare: già alla fine del Cinquecento un balcone rinascimentale sul fronte nord aveva reso inutilizzabile la caditoia. Nel catasto austriaco del 1831 risulta ridotta a rudere. Tra fine Ottocento e inizio Novecento venne demolita anche la vecchia porta nord, ormai d'intralcio all'espansione dell'abitato.

Nakon što je prestala osmanska opasnost, naselje se proširilo izvan zidina na tri strane, udvostručivši svoju površinu. Kula Cippico, koja je već krajem 16. stoljeća na sjevernom pročelju dobila renesansni balkon s balustradom, čime je mašikul izgubio svoju funkciju, ostala je bez ikakve vojne uloge. U austrijskom katastru iz 1831. zabilježena je kao ruševina u vlasništvu Luigija Cippica. Stara sjeverna vrata, koja su postala smetnja, srušena su između kraja 19. i početka 20. stoljeća.

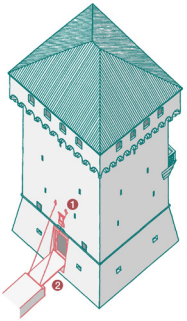


1996

Alla fine dell'Ottocento la famiglia Katalinić ricostruì la torre, conferendole il volume attuale, e le affiancò un magazzino vinicolo tra il 1903 e il 1925. Nel Novecento l'edificio fu destinato a usi pubblici: negli anni Sessanta e Settanta i solai lignei vennero sostituiti in cemento armato e dal 1968 ospitò la Galleria Studin, poi Museo della città di Kaštela. I restauri dei primi anni Duemila alterarono però finestre e coronamento, mentre nel 2005 il magazzino fu demolito e sostituito da un edificio estraneo al contesto.

Krajem 19. stoljeća obitelj Katalinić obnovila je kulu, dajući joj današnji volumen, te joj između 1903. i 1925. dograđila vinsko skladište. Tijekom 20. stoljeća građevina je služila javnu namjenu: šezdesetih i sedamdesetih godina drvene međukatne konstrukcije zamijenjene su armiranobetonskima, a od 1968. u njoj je djelovala Galerija Studin, iz koje je nastao Muzej grada Kaštela. Obnove početkom 21. stoljeća izmijenile su prozore i krunište, dok je skladište 2005. srušeno i zamijenjeno zgradom neprikladnom povijesnom kontekstu.

L'EVOLUZIONE DELLA TORRE
RAZVOJ KULE



LA PORTA NORD

La porta "di terra", sul fronte nord, era uno dei due accessi alla torre. Il tratto finale ligneo del ponte si sollevava mediante catene. I due fori in cui scorrevano si vedono ancora sopra la porta, all'altezza del primo piano. Prima dei lavori di inizio Duemila, sopra l'ingresso c'erano lo stemma Cippico e, sotto, una lastra di marmo con l'iscrizione sulla costruzione della torre, poi scalpellata; ai lati, due rilievi con la figura di un leone.

SJEVERNA VRATA

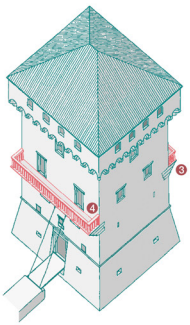
„Kopnena" vrata na sjevernom pročelju činila su jedan od dvaju ulaza u kulu. Završni dvores do mosta podizao se lancima. Dvije rupe kroz koje su lanci prolazili još se vide iznad vrata, u visini prvoga kata. Prije radova s početka dvijetisućitih iznad ulaza nalazili su se grb Cippica i, ispod njega, mramorna ploča s natpisom o gradnji kule, poslije otučena; sa strana, dva reljefa s likom lava.

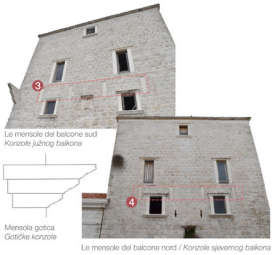


La porta nord / *Sjeverna vrata*



Il fronte nord della torre / *Sjeverno pročelje kule*





Le mensole del balcone sud
Konzole južnog balkona

Mensola gotica
Gotičke konzole

Le mensole del balcone nord / *Konzole sjevernog balkona*

LE MENSOLE E I BALCONI

Le mensole tronche sui fronti raccontano i due balconi perduti. Quello sud, verso il mare, nacque con la torre. Quello nord fu aggiunto alla fine del Cinquecento: attorno alle sue mensole si vedono i segni della muratura rimaneggiata, e le cassette che ne decoravano i fianchi ricordano quelle della torre di Kaštel Stafilić.

KONZOLE I BALKONI

Odrezane konzole na pročeljima svjedoče o dvama nestalim balkonima. Južni, okrenut prema moru, nastao je zajedno s kulom. Sjeverni je dodan krajem 16. stoljeća: oko njegovih konzola vide se tragovi preinaka zida, a kasete koje su ukrašavale bočne strane podsjećaju na one na kuli u Kaštel Stafiliću.

2026

Nel 2014 viene rimossa la ricostruzione incongrua della parte sommitale e la copertura viene ricondotta alla configurazione precedente all'intervento. Gli scavi del 2016 riportano alla luce gli scogli su cui poggia il muro nord dell'abitato e alcuni resti della cinta difensiva presso l'antica porta. Del ponte non emergono invece tracce materiali: il suo percorso presunto è oggi segnalato nella pavimentazione antistante con una diversa tessitura lapidea.

Godine 2014. uklonjena je neprimjerena rekonstrukcija gornjeg dijela, a krovište je vraćeno u konfiguraciju koja je prethodila tom zahvatu. Arheološka istraživanja iz 2016. otkrila su stijene na kojima počiva sjeverni zid naselja i ostatke obrambenog zida u blizini nekadašnjih vrata. Materijalni tragovi mosta nisu pronađeni; njegov pretpostavljeni pravac danas je označen u obliku drugačijim slaganjem kamena.



Le planimetrie ricostruttive e le assonometrie sono relaborazioni grafiche a partire da / *Rekonstrukcijski tlocrti i aksonometrije grafičke su prerade na temelju:* K. Marasović, *Kaštelanski kaštel, Kaštela: Muzej grada Kaštela; Split: Sveučilište u Splitu, 2025.*

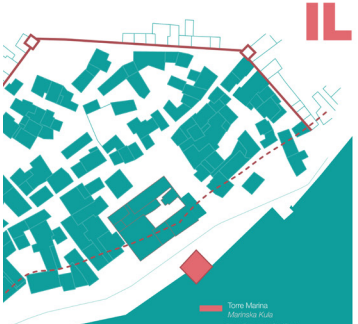


Rielaborazione da modello fotogrammetrico, 2026

Prerada prema fotogrametrijskom modelu, 2026.



IL BORGO E LA TORRE DI MARINA
NASELJE I MARINSKA KULA



L'INSEDIAMENTO NEL TEMPO ATTRAVERSO LE MAPPE
RAZVOJ NASELJA KROZ VRIJEME PREMA KARTOGRAFSKIM PRIKAZIMA



1854



Dalmazia nel Secondo rilevamento militare asburgico (1851–1854)
Dalmacija u Drugo vojno izmjeri Habsburške Monarhije (1851–1854)

1869



Dalmazia nella Terza rilevazione militare asburgica (1869–1887)
Dalmacija u Trećoj vojnoj izmjeri Habsburške Monarhije (1869–1887)

1887



Marina sulle mappe catastali della Monarchia asburgica (XIX secolo).
Marina na katastarskim kartama Habsburške Monarhije (19. stoljeće).

Le rilevazioni militari del 1854 e del 1869 mostrano Marina nel contesto della baia, evidenziandone il rapporto con la costa, il rilievo e le principali vie di collegamento. La carta catastale del 1887 restituisce invece con maggiore dettaglio il tessuto costruito, ormai esteso attorno al nucleo storico e lungo il fronte costiero.

Vojne izmjere iz 1854. i 1869. prikazuju Marinu u kontekstu zaljeva, ističući njezin odnos s obalom, reljefom i glavnim komunikacijskim pravcima. Katastarska karta iz 1887. detaljnije prikazuje izgrađeno tkivo, koje se tada već proširilo oko povijesne jezgre i duž obale.

BORGO

Tra la fine del Quattrocento e l'inizio del Cinquecento, il borgo di Marina sorse lungo la costa per proteggere la popolazione dalle incursioni ottomane. L'abitato si organizzò lungo il perimetro fortificato, integrando mura, residenze e spazi di vita in un unico sistema destinato alla difesa e al controllo della baia.

NASELJE

između kraja 15. i početka 16. stoljeća naselje Marina nastalo je uz obalu radi zaštite stanovništva od osmanskih upada. Naselje se razvilo duž utvrđenog perimetra, povezujući zidine, stambene prostore i prostore svakodnevnog života u jedinstven sustav obrane i nadzora nad zaljevom.





Rielaborazione da modello fotogrammetrico, 2026.

Obrada na temelju fotogrametrijskog modela, 2026.

L'ASSETTO ATTUALE DEL CASTELLO
DANAŠNJI IZGLED KAŠTELA

L'insieme costituisce un sistema difensivo unitario, organizzato attorno al castello e alla sua corte interna. Le murature perimetrali, integrate e modificate da interventi successivi, testimoniano la progressiva trasformazione dell'assetto originario

Cjelina čini jedinstven obrambeni sustav, organiziran oko kaštela i njegova unutarnjeg dvorišta. Obodni zidovi, nadograđivani i mijenjani tijekom kasnijih zahvata, svjedoče o postupnoj preobrazbi izvornog ustroja.



CASTELLO

Costruito intorno al 1500 per iniziativa del vescovo traurino Francesco Marcello, il castello di Marina, indicato anche come "cittadella", era protetto da mura e torri angolari. Protesso originariamente per metà nella baia e collegato alla torre mediante un ponte, fu interamente inglobato nella terraferma dal progressivo avanzamento della linea di costa.

KAŠTEL

Izgrađen oko 1500. godine na inicijativu trogirskog biskupa Franje Marcella, marinski kaštel, nazivan i „citadelom", bio je zaštićen zidinama i uglavnom kulama. Izvorno smješten napola u zaljevu i povezan s kopnom mostom, postupnim pomicanjem obalne linije u cijelosti je uklopljen u kopno.

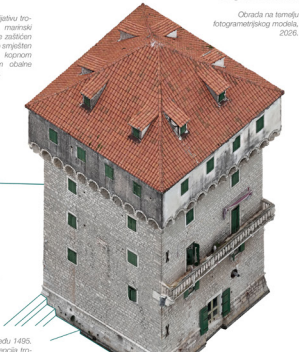


Foto d'epoca / *Povijesne fotografije*
Fonti / Izvori: Cipina Marina, *Povijest Marine* K. Horvat-Levaj, *Perasti u Stu – kuli, kuća i palača*, 2002, 33–48.



Foto da drone, 2026 / *Fotografija dronom, 2026*





L'ASSETTO ATTUALE DELLA TORRE
DANAŠNJI IZGLED KULE

FRONTE CHIESA

Della chiesa, integrata nelle mura del castello, resta il frontone, riconoscibile per il profilo sagomato e il piccolo campanile. Scomparso lo spazio interno, questo elemento sopravvive come traccia dell'antico edificio religioso e delle successive trasformazioni del complesso fortificato.

PROČELJE CRKVE

Crkva, uklopljena u zidine kaštela, sačuvan je zabat prepoznatljiv po očekivanom profilu i malom zvoniku. Nestankom unutarnjeg prostora, ona opstaje kao trag nekadašnje sakralne građevine i kasnijih preobrazbi koje je pretrpio utvrđeni kompleks.



TORRE

Edificata tra la fine del XV e l'inizio del XVI secolo come residenza fortificata del vescovo Francesco Marcello, la torre quadrangolare sorgeva isolata sugli scogli ed era raggiungibile mediante un ponte. Il coronamento aggettante, sostenuto da mensole, ne rafforzava la difesa; gli ambienti interni accoglievano funzioni militari e residenziali.

KULA

Četverokutna kula, sagrađena između 1495. i 1500. godine kao utvrđena rezidencija trogirskog biskupa Francesco Marcella, izvorno je bila izdvojena na hridima u zaljevu, dostupna pokretnim mostom. Korozivo djelovanje kruništa pojačavalo je njezinu obranu, dok su unutarnji prostori spajali vojnu i stambenu namjenu.

RESTAURO SOMMITALE

La fotografia mostra la torre nel suo stato attuale. L'area evidenziata corrisponde alla porzione sommitale ricostruita durante il restauro, in precedenza mancante a causa del degrado e della perdita degli elementi difensivi originari.



OBNOVA VRHA

Fotografija prikazuje kulu u njezinu današnjem stanju. Označeno područje odgovara gornjem dijelu rekonstruiranom tijekom obnove, koji je prethodno nedostajao zbog propadanja i gubitka izvornih obrambenih elemenata.



LEONE VENEZIANO

Il leone di San Marco testimoniava l'autorità della Repubblica di Venezia su Marina e costituiva, oltre all'elemento decorativo, un segno politico chiaramente riconoscibile sulla torre.

MLETAČKI LAV

Lav svetoga Marka svjedočio je o vlasti Mletačke Republike nad Marinom te je, osim dekorativne funkcije, predstavljao jasno prepoznatljiv politički znak na kuli.

INQUADRAMENTO STORICO
POVIJESNI KONTEKST

Avviato alla fine del XV secolo su iniziativa del vescovo di Trogir Francesco Marcello, il complesso fortificato di Marina nacque per proteggere la popolazione locale dalle incursioni. L'avanzamento della linea di costa e l'espansione dell'abitato ne hanno progressivamente modificato la relazione con il mare. Perduta la funzione difensiva originaria, la torre costituisce oggi un importante riferimento urbano e una testimonianza dell'architettura militare rinascimentale dalmata. Recentemente adattata a struttura ricettiva, ha mantenuto l'involucro storico mentre gli spazi interni sono stati ridistribuiti sotto il controllo degli organi di tutela, nell'ambito di un più ampio processo di rivitalizzazione.

Formiran krajem 15. stoljeća na inicijativu trogirskog biskupa Franje Marcella, utvrđeni kompleks Marine nastao je radi zaštite lokalnog stanovništva od osmanskih upada. Pomicanje obalne crte i širenje naselja postupno su promijenili njegov odnos prema moru. Nakon gubitka izvorne obrambene funkcije, kula danas predstavlja važnu urbanu točku i svjedočanstvo renesansne vojne arhitekture Dalmacije. Nedavno prilagođena ugostiteljsko-smještajnoj namjeni, zadržala je povijesni vanjski omotač, dok su unutarnji prostori preuređeni pod nadzorom konzervatorskih službi, u sklopu šireg procesa revitalizacije.

RAPPORTO CON IL TERRITORIO
ODNOS S TERITORIJEM

Catena montuosa della Boraja
Planinski lanac Boraja

Torre Marina
Kula Marina



La torre sorge nella parte più interna e riparata della baia di Marina, lungo la rotta marittima verso Trogir. Originariamente isolata sull'acqua, controllava l'accesso al golfo ed era collegata al recinto fortificato. L'interramento del braccio di mare l'ha progressivamente saldata alla costa e al tessuto urbano, sullo sfondo dei rilievi dell'entroterra.

Kula se nalazi u najzaštićenijem dijelu Marinskog zaljeva, uz pomorski put prema Trogiru. Izvorno odvojena od kopna, nalazila je ulaz u zaljev i bila povezana s utvrđenim sklopom. Zatrpavanje morskog rukavca postupno je je povezalo s obalom i urbanim tkivom, na pozadini reljefa dalmatinskog zaleđa.



CASTELVECCHIO E IL CASTEL CIPPICO
KAŠTEL STARI I KAŠTEL CIPPICO



Castel Cippico / *Kaštel Cippico*
Centro storico / *Stari grad*
Perimetro centro storico / *Perimetar stari grad*

INQUADRAMENTO STORICO
POVIJESNI KONTEKST

Coriolano Cippico (1425–1493), nobile di Traù e figlio dell'umanista Pietro, fu una delle figure di maggior rilievo della famiglia.
Nel 1478 ottenne dal conte Trollo Malipiero l'autorizzazione a costruire un castello con un abitato fortificato per proteggere uomini e proprietà dalle incursioni ottomane. Il castello fu realizzato nel 1481 e attorno ad esso si sviluppò rapidamente il villaggio, la cui cinta muraria venne finanziata da Venezia nel 1507.

Koriolan Cippico (1425.–1493.), trogirski plemić i sin humanista Petra, bio je jedna od najistaknutijih osoba svoje obitelji.
Godine 1478. od kneza Trolla Malipiera dobio je dopuštenje za izgradnju kaštela i utvrđenog naselja radi zaštite ljudi i posjeda od osmanskih upada. Kaštel je podignut 1481., a oko njega se brzo razvilo naselje, čije je zidine 1507. financirala Venecija.



Il castello a inizio Novecento / *Kaštel početkom 20. stoljeća. KO-ST (Konzervatorski odjel u Splitu) da / K. Marasović, Kaštelanski kaštelі, 2025.*



Il castello oggi, 2026 / *Kaštel danas, 2026.*

RAPPORTO CON IL TERRITORIO
ODNOS S TERITORIJEM



Il borgo di Castelvecchio (*Kaštel Stari*) si sviluppò in gran parte su terreni progressivamente sottratti al mare. Prima della fondazione del castello, la linea di costa raggiungeva il margine settentrionale dell'attuale piazza Brce e, poco al largo, affioravano gli scogli sui quali furono costruiti i kaštel e le torri vicine. L'antica strada Salona-Tragurium seguiva il tracciato della riva e conduceva all'ingresso occidentale dell'abitato. A due lati del nucleo scorrevano i torrenti Fuležina, che sfociando direttamente in mare funzionavano come fossati naturali e contribuirono a determinare la posizione dell'insediamento: oggi il loro corso è in gran parte coperto dalle strade. All'interno delle mura, presso l'angolo nord-orientale della piazza, il pozzo del villaggio garantiva l'approvvigionamento d'acqua anche durante gli assedi.

Naselje Kaštel Stari velikim je dijelom podignuto na nasipu iz mora, poje ćenutlja more ja dopirao do sjevernog ruba današnjeg Brca, a pred obalom su se nalazile hrpti na kojima su izgrađeni kaštel i susjedne utvrde. Trasa stare antičke ceste Salona–Tragurium pratila je izvorno obalu i vodila do zapadnog ulaza u naselje.
S obiju strana naselja prema moru spuštala su se dva potoka, oba nazvana Fuležina; prirodni obrambeni jarci koji su odredili položaj sela, danas nativnimi ulicama. Unutar zidina, u sjeveroistočnom uglu Brca, secala je bunar opskrbljivao stanovnike vodom i u doba opsade.

L'INSEDIAMENTO NEL TEMPO
NASELJE KROZ VRIJEME



1400

Alla metà del Quattrocento il mare raggiungeva ancora l'attuale piazza Brce e i torrenti Fuležina, sfruttati come fossati naturali, condizionarono la scelta del sito. Nel 1481 Coriolano Cippico costruì il castello sugli scogli, collegato alla riva da un ponte levatoio. Distrutto da un incendio, fu ricostruito nel 1492 con il sostegno del Senato veneziano e arricchito da un portico rinascimentale, mentre attorno si sviluppava il primo abitato.

Sredinom 15. stoljeća more je još dosezalo današnji trg Brce, a potoci Fuležina, korišteni kao prirodni jarci, utjecali su na izbor položaja. Godine 1481. Koriolan Cippico sagradio je kaštel na hridima, povezan s obalom pokretnim mostom. Nakon što je stradao u požaru, obnovljen je 1492. uz potporu mletačkog Senata i obogaćen renesansnim trijemom, dok se oko njega počelo razvijati prvo naselje.



1600

Il villaggio crebbe rapidamente e nel 1507, con il sostegno del Senato veneziano, fu cinto da mura sui tre lati verso terra: un rettangolo di 160 × 60 metri, protetto a nord da un fossato e ai lati da due torrenti, con tre torri, tre porte, rivellatore e cammino di ronda ligneo. Le difese furono messe alla prova nella notte del 13 giugno 1512, quando centinaia di cavalieri e fanti turchi assalirono l'abitato. Gli abitanti resistettero fino all'arrivo di tredici barche da Trau, che li evacuarono via mare.

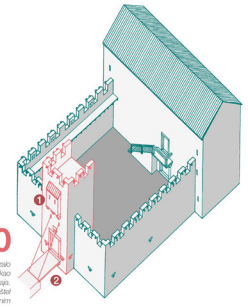
Naselje je brzo raslo pa je 1507., uz pomoć mletačkoga Senata, opasano zidinama s trju kopnenih strana: pravokutnik od 160 x 60 metara, branjen sa sjevera jarkom, a s bokova dvama potocima, s tri kule i troja vrata, krunišem i drvenim ophodom. Obrana se pokazala dobrta potrebnom: u noći 13. lipnja 1512. Osmanlije su napali selo sa stotinama konjanika i pješaka, ali su se stanovnici, koji su noću naišli sklonište u kaštelu, branili do dolaska tiđaset brodova iz Trogira, koji su ih morem odveli na sigurno.

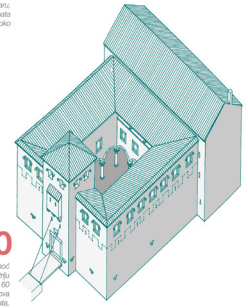


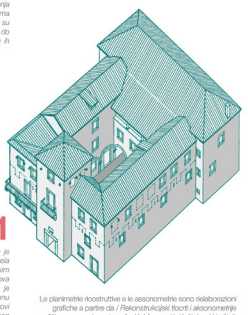
1831

Con il venir meno del pericolo ottomano, il villaggio cambiò volto. I bassifondi ai lati del castello furono colmati e si formò la piazza Brce; nel 1714 una nuova chiesa barocca sostituì quella rinascimentale. Il castello fu adattato ad abitazione: il portico venne tamponato, la torre trasformata in alloggio autonomo e le mensole della bertesca riutilizzate per l'attuale balcone.

Prestankom osmanske opasnosti naselje je promijenilo lice. Plićaci s obiju strana kaštela su nasuti i nastao je trg Brce, sa secećim bunarom i barokinim tđanđarom; 1714. nova barokna župna crkva zamijenila je renesansnu. I kaštel je, izgubivši obrambenu ulogu, preuređen za stanovanje: lukovi trijema su zazidani, kula je postala zaseban stan, a konzole bretđa iskorištene su za današnji balkon







La planimetrie ricostruttive e le assonometrie sono rielaborazioni grafiche a partire da / *Rekonstrukcijski tlocrti i aksonometrije grafičke su prerađe na temelju: K. Marasović, Kaštelanski kaštelі, Kaštela: Muzej grada Kaštela; Split: Sveučilište u Splitu, 2025.*

L'EVOLUZIONE DEL CASTELLO
RAZVOJ KAŠTELA

LA PORTA NORD

La torre conserva ancora la porta d'ingresso originaria, sormontata dallo stemma del Cippico e dall'iscrizione del 1481. Accanto alla finestra, sotto l'intonaco, si riconoscono le aperture che servivano a sollevare il ponte levatoio; più in alto, le mensole forate che un tempo reggevano la bertesca scelengono oggi il balcone. La soglia attuale non è quella originaria: fu rialzata nel corso dei secoli, seguendo il livello della piazza, cresciuto insieme a quello del mare.

SJEVERNA VRATA

Na kuli su sačuvana izvorna ulazna vrata, a nad njima grb obitelji Cippico i natpis iz 1481. godine. Uz prozor se ispod žbuke raspoznaju otvori koji su služili za podizanje pokretnog mosta; više gore, probušene konzole koje su nekoć nosile bretele danas dižu balkon. Današnji prag nije izvorni: podignut je tijekom stoljeća, prateći razinu tla koja je rasla zajedno s razinom mora.



Le tracce del ponte levatoio
Tragovi pokretnog mosta



La porta d'ingresso / *Ulazna vrata*

La torre, lo stemma e l'iscrizione
Sjeverno pročelje kule



Le finestre del prospetto sud
Prozori južnoga pročelja

La bifora con il balcone / *Bifora s balkonom*

FINESTRE RINASCIMENTALI

Le finestre del prospetto sud raccontano la trasformazione del castello in dimora. Le prime furono aperte al secondo piano, il piano nobile: due monofore e una trifora, in seguito trasformata nell'attuale bifora con balcone, sulla cui balaustra sono scolpiti gli stemmi di famiglia. Più tardi anche il primo piano, adattato ad abitazione, ebbe le sue finestre rinascimentali; altre due sono copie aggiunte nel 1939. Un davanzale dal profilo gotico rivela infine le aperture più antiche, scettrute già prima del 1481.

RENESANSNI PROZORI

Prozori južnoga pročelja svjedoče o pretvorbi kaštela u dom. Prvi su otvoreni na drugom katu, piano nobile: dvije monofore i trifora, poslije prebvorena u današnju bifioru s balkonom, na čijoj su ogradi ukleseni obiteljski grbovi. Poslije je i prvi kat, preuređen za stanovanje, dobio renesansne prozore; još su dva kasnije dodane 1909. godine. Prag gotičke profilacije otkriva, naposlijetku, najstarije otvore, zamjetljive još prije 1481.

2026

Il castello, diviso tra molti proprietari, nel 1909 ospitò perfino un albergo; il restauro del lato orientale, nel 1986, ha riportato alla luce il portico rinascimentale, e nel 2008 è ricomparso, sopra il secondo piano,un soffitto rinascimentale a cassettoni dipinto. Nel 2022 il ponto è stato riqualificato e gli scavi davanti al castello hanno riportato alla luce l'antica linea di riva e i resti di un ponte ligneo del Seicento.

Kaštel je podijeljen među mnogim vlasnicima, a 1909. u njemu je otvoren čak i hotel; obnovom istočnoga krila 1986. otkriven je renesansni trijem, a 2008. iznad drugoga kata pronađen je renesansni oslikani kasetirani strop. Godine 2022. uređena je luka, a iskopavanja pred kaštelom otkrila su nekadašnju obalu i ostatke drvenog mosta iz 17. stoljeća.



Rielaborazione da modello fotogrammetrico, 2026

Obrada na temelju fotogrametrijskog modela, 2026



CASTEL STAFILEO E IL BORGO
KAŠTEL ŠTAFILEO I NASELJE



INQUADRAMENTO STORICO
POVIJESNI KONTEKST

Fondato nel 1508 dal nobile traurino Stjepan Stafileo, Castel Stafileo nacque come avamposto militare per difendere i contadini locali dalle incursioni ottomane. Il progressivo avanzamento della linea di fronte e la profonda antropizzazione hanno inglobato la struttura nella terraferma. Persa la sua originaria vocazione difensiva, il castello è divenuto il fulcro di un denso nucleo abitativo. Oggi conserva ancora leggibili i caratteri principali dell'impianto originario, pur all'interno di un tessuto urbano profondamente trasformato.

Osnovao ga je 1508. godine trogirski plemić Stjepan Štafileo, a kaštel Štafić nastao je kao vojna utvrda za obranu lokalnih težačkih obitelji od osmanskih upada. Postupno napredovanje obalne linije i snažna antropizacija uklopili su gradevinu u kopno, izgubivši svoju izvornu obrambenu svrhu. kaštel je postao jezgra zbijenog stambenog naselja. Danas predstavlja vrijedan primjerak dalmatinske renesansne vojne arhitekture.



Foto del lato Est, 2018 / *Slika istočne strane, 2018. ds / Ur. K. Marasović, Kaštelanski kaštel, 2025.*



Foto da drone, 2026 / *Fotografija dronom, 2026.*

RAPPORTO CON IL TERRITORIO
ODNOS S TERITORIJEM

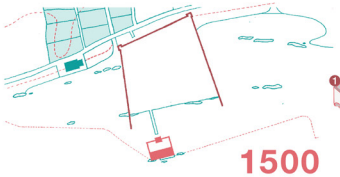


Castel Stafileo, da cui prende il nome l'attuale insediamento di Kaštel Štafilić, costituisce uno degli elementi principali del suo impianto urbano. La sua posizione sul fronte costiero lo pone in stretta relazione con il tessuto dell'abitato e con il territorio retrostante, che si estende verso nord.

Kaštel Štafilić jedan je od glavnih elemenata urbanističke strukture Kaštel Štafilića. Njegov položaj uz obalu utiče ga povezuje s ostalim naseljima i područjem u zaleđu, koje se prostire prema sjeveru.



L'INSEDIAMENTO NEL TEMPO
NASELJE KROZ VRIJEME



1500

In questa fase iniziale la fortificazione interagisce direttamente con l'acqua: la torre principale meridionale risulta isolata e costruita in mare, collegata al recinto principale sulla terraferma. L'assenza di dati cartografici certi non ci permette di determinare la geometria del nucleo abitativo, ma sicuramente il castello fungeva da fulcro e rifugio per la popolazione sparsa che lavorava i campi limitrofi.

U ovoj početnoj fazi utvrda je bila u neposrednom odnosu s morem: glavna južna kula bila je izdvojena i izgrađena u moru te povezana s glavnim utvrđenim zaklonom na kopnu. Nedostatak pouzdanih kartografskih podataka ne omogućuje određivanje geometrije naseljske jezgre, no kaštel je zasigurno služio kao središte i zaklon razdanom stanovništvu koje je obrađivalo okolna polja.



1830

La costa ha subito un massiccio intervento di antropizzazione e la linea di riva si è allargata verso il mare: la torre è stata completamente "assorbita" dalla terraferma. Il recinto del castello ha perso la sua funzione esclusivamente militare, diventando il contenitore di un denso nucleo abitato.

Obala je doživjela snažnu antropogenu preobrazbu, a obalna se crta pomaknula prema moru: kula je u potpunosti „apsorbirana" kopnom. Ograđeni prostor kaštela izgubio je svoju isključivo vojnu funkciju i postao prostor guste naseljske jezgre.

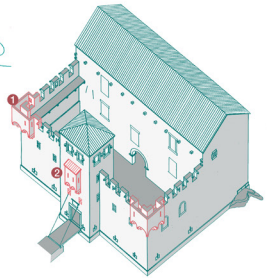


2006

Il nucleo storico mantiene il suo impianto originario ma il rapporto con il territorio circostante muta profondamente. Si assiste a una forte espansione edilizia che oltrepassa la vecchia arteria di collegamento e si espande verso nord. L'area costiera perde definitivamente il suo carattere difensivo, configurandosi come un moderno lungomare urbano.

Povijesna jezgra zadržava svoju izvornu strukturu, dok se njezin odnos s okolnim prostorom znatno mijenja. Dolazi do snažne izgradnje koja prelazi nekadašnju prometnicu povezivanja i širi se prema sjeveru. Obalno područje konačno gubi svoj obrambeni karakter i oblikuje se kao suvremena gradska obalna šetnica.

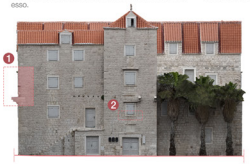
L'EVOLUZIONE DEL CASTELLO
RAZVOJ KAŠTELA



LA PORTA NORD
SJEVERNA VRATA

La porta "di terra", sul fronte nord, era l'unico accesso al castello. L'ultimo tratto ligneo del ponte si sollevava con catene, i cui fori sono ancora visibili sopra l'ingresso.

„Kopnena" vrata na sjevernom pročelju bila su jedini ulaz u kaštel. Posljednji dijelovi drvenog mosta podizao se lancima, čiji su otvori još vidljivi iznad ulaza.

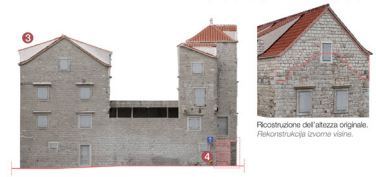


Feritoie per il sistema di movimento del ponte.
Pronzi za mehanizam pokretanja pokretnog.

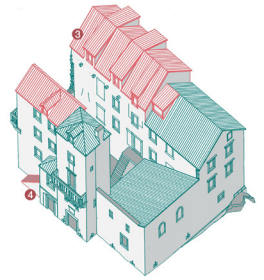
LA FINE DEL RUOLO DIFENSIVO
KRAJ OBRAMBENE ULOGE

Cessata la minaccia ottomanna, Castel Stafileo assunse una funzione prevalentemente residenziale. Il nuovo uso comportò il rialzamento di un piano e la costruzione di una scala d'accesso sul fronte nord.

Nakon prestanka osmanske opasnosti, kaštel Štafilić dobio je pretežno stambenu namjenu. Nova je funkcija dovela do nadogradnje jednog kata i izgradnje prestupnog stubišta na sjevernom pročelju.



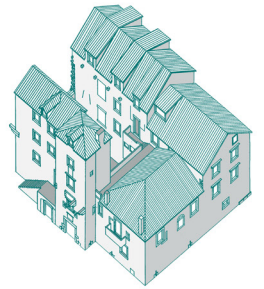
Ricostruzione dell'altezza originale.
Rekonstrukcija izvorne visine.



2026

I recenti restauri hanno ulteriormente trasformato Castel Stafileo: nell'ala nord-occidentale il tetto a padiglione è stato sostituito da una copertura piana, mentre sulla facciata principale è stato rimosso l'ultimo balcone. Il fronte occidentale verso il mare è stato inoltre sopraelevato di un piano, riprendendo il motivo delle falde sfalsate introdotto nei restauri ottocenteschi.

Nedavni restauratorski zahvati dodatno su izmijenili Kaštel Štafilić: na sjevercapadnom krilu četverostrešni krov zamijenjen je ravnim, dok je s glavnog pročelja uklonjen posljednji balkon. Zapadno pročelje prema moru također je nadograđeno za jednu etažu, ponavljajući motiv razlomljenih krovnih ploha uveden tijekom obnove u 19. stoljeću.



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Rielaborazione da modello fotogrammetrico, 2026.
Obrada na temelju fotogrametrijskog modela, 2026.



CASTEL ABBADESSA E IL KAŠTILAC

KAŠTEL GOMILICA I KAŠTILAC



Castel Abbadessa
Kaštel Gomilica

Centro storico
Stari grad

Perimetro insediamento fortificato
Perimetar utvrđenog naselja

Cambiamento della linea costiera
Promjena obalne crte

INQUADRAMENTO STORICO
POVIJESNI KONTEKST

Fondato nel 1545 dalle monache benedettine di Spalato, Castel Abbadessa nacque come insediamento fortificato per difendere i contadini locali dalle incursioni ottomane. Originariamente eretto su un isolotto, i successivi interramenti costieri e la profonda antropizzazione hanno inglobato la struttura nella terraferma. Persa la sua originaria vocazione difensiva, il castello è divenuto il fulcro di un denso nucleo abitativo.

Osnovan 1545. godine od strane splitskih benediktinki, Kaštel Gomilica nastao je kao utvrđeno naselje za obranu lokalnog stanovništva od osmanskih provala. Izvorno podignuta na otočiću, utvrda je usljed kasnijih nasipanja obale i intenzivne antropizacije spojena s kopnom. Gubitkom svoje izvorne obrambene namjene, kaštel je postao središte gustog stambenog jezgra.





Foto storiche da / *Povijesne fotografije iz:* K. Marasović, Kaštelanski kaštel, 2025, 127, 157.

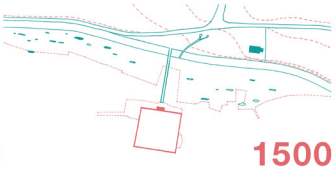
RAPPORTO CON IL TERRITORIO
ODNOS S TERITORIJEM



Castel Abbadessa rappresenta un caso studio paradigmatico del rapporto tra architettura e paesaggio costiero dalmata. Tale vocazione si riflette a livello urbano, in quanto la posizione del complesso ha condizionato lo sviluppo del nucleo abitato cinquecentesco, organizzato attorno all'isolotto fortificato e collegato alla terraferma da un ponte in pietra. La fortezza si adatta alla forma dello scoglio, conciliando esigenze difensive e caratteristiche del sito costiero.

Kaštilac predstavlja paradigmatski primjer odnosa između arhitekture i dalmatinskog obalnog krajolika. Ta se posebnost očituje i na urbanističkoj razini, budući da je položaj utvrđa odredio razvoj okolnog naselja, organiziranog oko utvrđenog otočića koji je s kopnom povezan kamenim mostom. Konfiguracija utvrde proizašla iz prilagodbe obrambenih struktura obalnu hridi, spajajući vojne zahtjeve s morfološkim obilježjima obalnog lokaliteta.

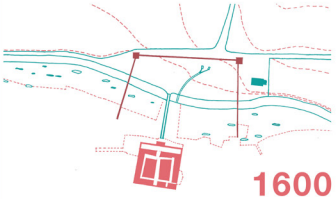
L'INSEDIAMENTO NEL TEMPO
NASELJE KROZ VRIJEME



1500

In questa fase embrionale, la fortificazione si erge completamente isolata all'interno dello specchio acqueo. La massiccia struttura a pianta quadrata è collegata alla terraferma esclusivamente tramite un lungo ponte. L'assenza di un nucleo abitato strutturato sulla costa evidenzia come il castello avesse una funzione di avamposto militare e di potenziale rifugio per la popolazione dedita allo sfruttamento agricolo dell'entroterra.

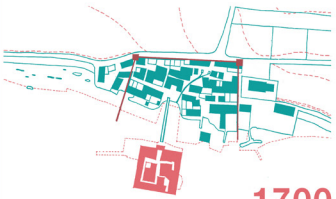
U ovoj početnoj fazi utvrda je u izravnom dodiru s vodom: glavni južni toranj je izoliran i izgrađen u moru te povezan s glavnim zidinama na kopnu pomoću pokretnog mosta. Nedostatak puzdanih kartografskih podataka ne stambene jezgre, ali dvorac je sigurno služio kao središte i utočište raspršenom stanovništvu koje je obrađivalo okolna polja.



1600

L'impianto difensivo subisce un notevole potenziamento verso la terraferma. In asse con il ponte, viene eretto un ampio recinto fortificato, delimitato da mura e protetto da due torri angolari settentrionali. Pur non mostrando ancora una densa edificazione interna, questo nuovo spazio protetto crea una sicura area di pertinenza, fungendo da cerniera tra la struttura marittima e le vie di comunicazione rurali.

Odnos između obrane i teritorija duboko se mijenja. Utvrđena zgrada na kopnu postupno se ruši ili apsorbira, ostavljajući prostor za razvoj guste i raspojasane naseljene jezgre. Naselje se organski širi napose dno uz obalu i duž prometnih pravca. Unatoč zadržavanju izoliranе strukture u moru, kopneno područje poprima izraženi stambeni i civilni karakter.

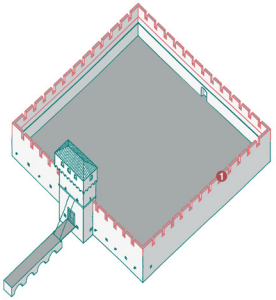


1700

Il rapporto tra le difese e il territorio muta profondamente. Il recinto fortificato sulla terraferma viene progressivamente smantellato o assorbito, lasciando spazio allo sviluppo di un denso e frammentato nucleo abitato. L'insediamento si espande organicamente a ridosso della costa e lungo gli assi viari. Pur mantenendo la struttura isolata in mare, l'area terrestre assume un marcato carattere residenziale e civile.

Odnos između obrambenih zdanja i teritorija duboko se mijenja. Utvrđeni pojas na kopnu postupno se ukida ili apsorbira, prepuštajući mjesto razvoju gustog i fragmentiranog naselja. Naselje se organski širi uz samu obalu i duž prometnih osi, iako zadržava strukturu izoliranu u moru, kopneno područje poprima izraženi stambeni i civilni karakter.

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L'EVOLUZIONE DEL CASTELLO
RAZVOJ KAŠTEL

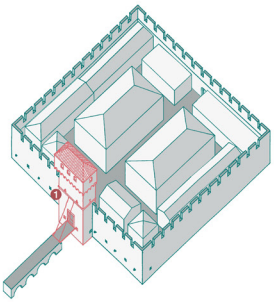
LE MERLATURE

Perso il ruolo esclusivamente difensivo della fortezza, i muri perimetrali del XVI secolo vengono ascritti dalle nuove strutture realizzate a scopo abitativo. Nonostante ciò, in alcuni punti la traccia delle vecchie merlature è ancora ben distinguibile.

KRUNISTA

Gubitkom isključivo obrambene uloge utvrde, obodni zidovi iz 16. stoljeća uklopljeni su u nove strukture izgrađene u stambene svrhe. Unatoč tome, na pojedinim mjestima tragovi starih kruništa još su uvijek jasno prepoznatljivi.





LA PORTA NORD

La torre d'ingresso del "Kaštilac" garantiva il controllo strategico degli accessi e ancora oggi mostra alcuni dettagli architettonici tipici delle fortificazioni croate del XIV secolo. Sono ancora ben visibili i fori in facciata che guidavano le funi del ponte levatoio e l'apparato a sporgere che ospitava le caditoie per la difesa piombante.

SJEVERNA VRATA

Ulazna kula Kaštilca osiguravala je strateški kontrolu pristupa i još danas pokazuje određene arhitektonske detalje tipične za hrvatske fortifikacije iz 14. stoljeća. Još uvijek su jasno vidljivi otvori na pročelju koji su služili za vođenje užadi pokretnog mosta, kao i konzolni istak u kojemu su se nalazili otvori za vertikalnu obranu.

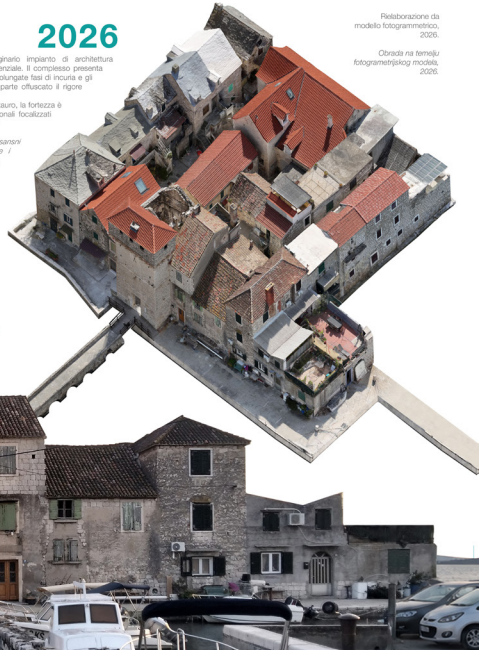


2026

La struttura conserva ancora il suo originario impianto di architettura rinascimentale a uso misto, difensivo e residenziale. Il complesso presenta attualmente alcune criticità conservative: le prolungate fasi di incuria e gli adattamenti abitativi successivi ne hanno in parte offuscato il rigore estetico originario.

Per quanto concerne i recenti interventi di restauro, la fortezza è stata inserita all'interno di progetti sovranazionali focalizzati sulla gestione sostenibile della fascia litoranea.

Struktura i dalje zadržava svoj izvorni renesansni arhitektonski koncept mješovite, obrambene i stambene namjene. Kompleks se trenutno nalazi u stanju djelomičnog propadanja: dugotrajna razdoblja nebrige i naknadne stambene prilagodbe djelomično su narušile njegovu izvornu estetiku dosljednost. Što se tiče nedavnih restauratorskih zahvata, utvrda je uključena u nadnacionalne projekte usredotočene na održivo upravljanje obalnim pojasom.



Rielaborazione da modello fotogrammetrico, 2026.

Obrada na temelju fotogrametrijskog modela, 2026.

SEGHETTO BASSO
SEGET DONJI



L'INSEDIAMENTO NEL TEMPO ATTRAVERSO LE MAPPE
RAZVOJ NASELJA KROZ VRIJEME PREMA KARTOGRAFSKIM PRIKAZIMA



Catasto franceschino — *Austrijski katastar*

Il catasto restituisce con precisione l'impianto compatto del borgo fortificato, la suddivisione interna degli isolati e il rapporto tra il recinto storico e le prime trasformazioni sviluppate al suo margine.

Katastar precizno prikazuje zbijenu strukturu utvrđenog naselja, unutarnju podjelu blokova te odnos povijesnog obrambenog perimetra i prvih proširenja uz rivu.



Carta del territorio di Trogir — *Karta trogirskog teritorija*

Seghetto appare come un piccolo nucleo costiero ancora nettamente distinto dal territorio agricolo circostante, in stretta relazione con la riva e con le principali vie di collegamento.

Seget je prikazan kao malo obalno naselje, još jasno odvojeno od okolnog poljoprivrednog prostora i povezano s obalom i glavnim komunikacijskim pravcima.



XVIII sec. / 18. st.

J-B d'Anville, Carta del territorio di Traù — *J-B d'Anville, karta trogirskog podrucja*

Alla scala territoriale Seghetto compare lungo l'asse costiero a ovest di Traù, mostrando la sua posizione all'interno della rete di centri, strade e approdi che strutturava il territorio della città.

Na teritorijalnoj razini Seget se nalazi uz obalu, u zapadnom dijelu trogirskog polja, kao jedno od naselja trogirskog teritorija, povezanog mrežom putova i pristaništa.

INQUADRAMENTO STORICO
POVIJESNI KONTEKST

Nel territorio di Seghetto la difesa organizzata precedette la fondazione del borgo: già nella seconda metà del Quattrocento una torre controllava il campo, passando nel 1516 alla famiglia Statileo. Nel 1564 il conte di Traù Augustin Bembo autorizzò Jakov Rotondo a costruire una torre sul mare, collegata alla riva da un ponte levatoio, e un recinto fortificato destinato ad accogliere e proteggere gli abitanti. Il nuovo insediamento crebbe rapidamente e nel 1578 contava già 122 residenti.

Na području Segeta organizirana obrana prethodila je osnivanju naselja: već je u drugoj polovini 15. stoljeća jedna kula nadzirala polje, a 1516. prešla je u vlasništvo obitelji Statileo. Godine 1564. trogirski knez Augustin Bembo dopustio je Jakovu Rotondu da podigne kulu na moru, povezanu s okolnim poletnim mostom, te utvrđeni prostor namijenjen smještaju i zaštiti stanovnika. Novo se naselje brzo razvijalo i 1578. već je imalo 122 stanovnika.



Seget, primi del '900 / *Seget početkom 20. stoljeća*
Da / *Preuzeto s:* Trogir Time Travel



Foto da drone, 2026 / *Fotografija dronom, 2026*

RAPPORTO CON IL TERRITORIO
ODNOS S TERITORIJEM



Seghetto sorse sulla costa a ovest di Traù, tra il mare e i terreni agricoli dell'entroterra, completando la sequenza di fortificazioni poste a protezione dei possedimenti locali. Il recinto manteneva un rapporto diretto con il territorio circostante: le porte collegavano l'abitato al campo, alla costa e alla strada verso Traù. Mare, percorsi e aree coltivate entrarono così direttamente nell'organizzazione del nuovo insediamento.

Seget je nastao na obali zapadno od Trogira, između mora i poljoprivrednih površina u zaleđu, nadopunjujući niz utvrda podignutih radi zaštite lokalnih posjeda. Utvrđeni je sklop bio izravno povezan s okolnim prostorom: vrata su povezivala naselje s poljem, obalom i cestom prema Trogiru. More, putovi i obradive površine tako su postali sastavni dio organizacije novog naselja.

CARATTERI ED ELEMENTI DELL'INSEDIAMENTO
OBILJEŽJA I ELEMENTI NASELJA

Seghetto conserva un impianto compatto e quasi rettangolare. Due assi principali si incrociano presso la piazza con la chiesa della Madonna del Rosario, che costituisce il fulcro collettivo dell'abitato; le case si addossano alle mura.

Seget čuva zbijenu i gotovo pravokutnu strukturu. Dvije glavne ulice sijeku se uz trg s crkvom Gospe od Ružarija, koja predstavlja glavno zajedničko središte naselja; kuće su prislonjene uz zidine.





1. Chiesa della Madonna del Rosario / *Crkva Gospe Od Ružarija*

LE TORRI ANGOLARI

Quattro torri quadrangolari, sporgenti dalla cortina, presidiavano gli angoli del recinto. Basamenti a scarpa e aperture per il tiro concentravano qui la difesa attiva; le mura, alte circa 4 m e spesse 60 cm, avevano soprattutto funzione protettiva. Delle quattro torri, tre si conservano ancora parzialmente, oggi inglobate nel tessuto urbano.

UGAONE KULE

Četiri četverokutne kule, istaknute iz linije zidina, štitile su uglove utvrđenog sklopa. Skošena podnožja i otvori za gađanje koncentrirali su aktivnu obranu u kulama; zidine, visoke oko 4 m i debele oko 60 cm, ponajprije su imale zaštitnu funkciju. Od četiri kule tri su se djelomično sačuvale i danas su uključene u urbano tkivo.



2. Torre nord-est / *Sjeveroistočna kula*



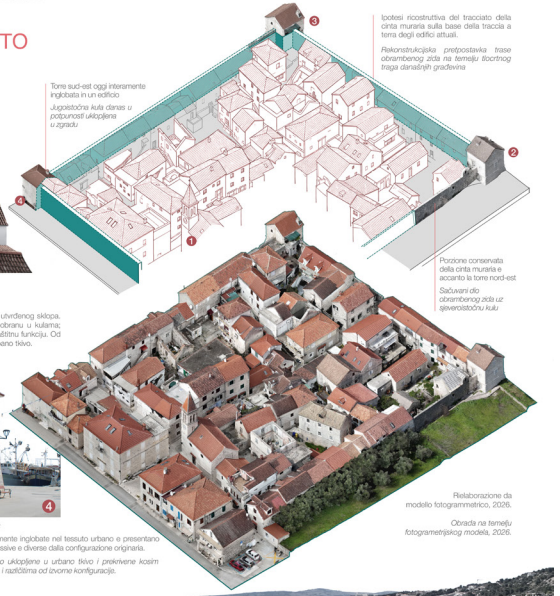
3. Torre nord-ovest / *Sjeverozapadna kula*



4. Torre sud-ovest / *Jugozapadna kula*

Le tre torri superstiti sono oggi parzialmente inglobate nel tessuto urbano e presentano copertura a falde, aggiunte in fasi successive e diverse dalla configurazione originaria.

Tri sačuvane kule danas su djelomično uključene u urbano tkivo i prekrivene kosim krovovima, dodanima u kasnijim fazama i različitima od izvorne konfiguracije.





PHOTOGRAPHIC GALLERY




Venetian Borderscapes






K.u.K. 1825


Jana




Venetian Borderscapes
Digital documentation for the study of settlement patterns
in the fortified landscapes of the Central Dalmatia




Venetian Borderscapes






Recovery, Conservation, and Enhancement of Cultural Heritage from the Venetian Serenissima Republic in Istria, Dalmatia, and the Mediterranean Area
DALMATIA
Venetian Borderscapes
Digital documentation for the study of settlement patterns in the fortified landscapes of the Central Dalmatia
Marks on the Frontier
Settlements and Landscape of Venetian Dalmatia
International Exhibition
6 - 12 September 2026
Porta Palio, Verona
19 - 26 October 2026
Tvrđava Barone, Šibenik


METODOLOGIA APPLICATA
RILIEVO DIGITALE
ELABORAZIONE DATI
MODELLAZIONE 3D
3D MODELIRANJE




CASTEL STAFILEO E IL BORGO
KAŠTEL STAFILEO I NASELJE
L'INSEDIAMENTO NEL TEMPO
NASELJE KROZ VRIJEME
INQUADRAMENTO STORICO
POVIJESNI KONTEKST
RAPPORTO CON IL TERRITORIO
ODNOS S TERITORIJEM
1500
1830
2006
2026


SEGHETTO BASSO
SECOLI DORATI




IL PROGETTO DI RICERCA
STRATEGIC PROJECT
STORIA E FORMA




I KASTEL NELLA CITTÀ CONTEMPORANEA
KASTELU SO FRAMENTU SIADU



CREDITS



RESEARCH PROJECT

Il progetto di ricerca "Venetian Borderscapes – Digital documentation for the study of settlement patterns in the fortified landscapes of Central Dalmatia" è co-finanziato dalla Regione del Veneto nell'ambito del bando 2025 dedicato ai progetti di recupero, conservazione e valorizzazione del patrimonio culturale risalente alla Repubblica Serenissima di Venezia in Istria, Dalmazia e nell'area mediterranea.
Il Dipartimento di Architettura dell'Università degli Studi di Firenze, capofila del progetto, ha condotto la ricerca insieme all'Institut za povijest umjetnosti di Zagabria e alla Tvrđava kulture Šibenik con il supporto di SMS Porta Palio.
La ricerca ha indagato, attraverso lo studio delle fonti storiche e mediante tecniche di rilievo e documentazione digitale, i modelli insediativi fortificati sviluppatisi lungo la costa della Dalmazia centrale tra Spalato, Traù, Sebenico e Zara. Il progetto ha riguardato la costruzione di archivi digitali e banche dati tridimensionali a supporto dello studio delle relazioni tra forma urbana, sistemi difensivi e trasformazioni storiche, mettendo in evidenza il ruolo della presenza veneziana nella configurazione del paesaggio costruito dell'Adriatico orientale.

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The present volume brings together the proceedings of the study day held on 6 September 2026 at Porta Palio, Verona, and the research findings presented in the touring exhibition staged alongside the event and at Barone Fortress, Šibenik. These initiatives form part of Venetian Borderscapes, a project promoted by the Veneto Region and coordinated by the University of Florence within the programme for the recovery, conservation and enhancement of the cultural heritage of the Most Serene Republic of Venice in Istria, Dalmatia and the Mediterranean.

Dedicated to understanding and enhancing central Dalmatia's fortified landscapes, the project conducts a census and analysis focused on the settlement patterns of the kaštel, coastal settlements developed under Venetian rule.Through digital documentation, the research develops 3D databases and representational tools for an integrated understanding of the settlements' architectural and territorial characteristics.

Historical and cartographic sources, combined with three-dimensional surveying, reveal new insights into settlement organisation and the morphological, typological and constructional characteristics of the fortified settlements, supporting further research, conservation and enhancement efforts. The settlements, examined in detail in the present research, Kaštel Gomilica, Kaštel Stari, Kaštel Novi and Kaštel Štafilić, together with Marina, Seget and Vodice, bear witness to this landscape mosaic, reflecting the Serenissima's strategies for defence and territorial organisation along the Dalmatian coast.

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