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The Generalato of the Lazzaretto Vecchio in Venice: Methodologies of Historic Research and Damage Assessment in Built Heritage

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Therefore, when we build, let us think that we build for ever.
Let it not be for present delight, nor for present use alone;
let it be such work as our descendants will thank us for,
and let us think, as we lay stone on stone, that a time is to come
when those stones will be held sacred because our hands have touched them (…).
For, indeed, the greatest glory of a building is not in its stones, nor in its gold.
Its glory is in its Age, and in that deep sense of voicefulness, of stern watching,
of mysterious sympathy, nay, even of approval or condemnation,
which we feel in walls that have long been washed by the passing waves of humanity.
It is in their lasting witness against men, in their quiet contrast with the
transitional character of all things, in the strength which, through the lapse of
seasons and times, and the decline and birth of dynasties,
and the changing of the face of the earth, and of the limits of the sea,
maintains its sculptured shapeliness for a time insuperable,
connects forgotten and following ages with each other.

John Ruskin, *The Seven Lamps of Architecture*

To Manoel and Aparecida,
also known as Papai e Mamãe.
You may not understand the words written here,
but my love for you will always transcend any language barrier.

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Acknowledgments

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Abstract – English version

The Lazzaretto Vecchio of Venice is recognised as the world's first institutionalised centre for managing plague outbreaks. Established in 1423 by decree of the Venetian Republic on the island of Santa Maria di Nazareth, the site repurposed the existing structures of an Augustinian monastic complex, transforming them into a permanent facility dedicated to the treatment and prevention of plague contagion. This role continued until the French and later Austrian occupations, during which the island was converted into a military outpost. Civil use of the site resumed only in 1979, and in 1998 it was designated as the future location of the National Archaeological Museum of the Venice Lagoon. Following the decommissioning of the public lazaretto, several buildings within the historic complex were either partially or entirely demolished, and the remaining structures experienced significant deterioration as a result of the island's prolonged abandonment. Despite plans for cultural redevelopment, restoration efforts have been continuously hindered by a persistent lack of funding.

This thesis explores the spatial organisation and architectural transformation of the Lazzaretto Vecchio across the centuries. Drawing upon a diverse array of historical, archival, and iconographic sources, it aims to establish a detailed chronology of the site's change. Special focus is given to the building known as the Generalato, originally the convent of the Augustinian friars and later adapted to accommodate and treat distinguished officers and diplomats of the Venetian Republic. This building has been studied also through a series of various digital tools for understanding its structural analysis and reconstruction.

This work investigates the architectural, formal, and constructional features of the Generalato prior to its partial demolition in the mid-19th century, integrating findings from on-site surveys with historiographical research. It also examines the structural degradation mechanisms affecting the surviving structures of the building, offering proposals for future investigations that should precede any restoration work. These contributions are intended as valuable insights to the broader process of recovery and conservation of the structure.

Employing a multidisciplinary approach, this thesis integrates Historical Geographic Information Systems (HGIS), Computer-Aided Design (CAD), and 3D modelling softwares to process, digitise, interpret, and visualise a historically significant—yet heavily altered—structure. This integrated methodology not only documents the current condition of the building, but also facilitates a critical reconstruction of its historical phases and architectural transformations. The resulting virtual reconstruction serves as a valuable and innovative tool for the preservation,

valorisation, and dissemination of built heritage. By offering a comprehensive understanding of both the material and immaterial aspects of the site, this research contributes to the broader discourse on Venetian architectural history and provides new insights into the cultural and historical landscape of the Venetian Lagoon.

Keywords: Venice; Architecture; Reconstruction; Digitalisation.

Abstract – Versione italiana

Il Lazzaretto Vecchio di Venezia è noto per essere stato il primo centro per la gestione della peste al mondo, istituito nel 1423 per decreto della Serenissima nell'isola di Santa Maria di Nazareth riconvertendo le antiche fabbriche di un complesso monastico agostiniano in una struttura permanente per la cura e la prevenzione del contagio del morbo. Svolse questo ruolo sino alle occupazioni francese e poi austriaca, durante la quale l'isola fu convertita in un presidio militare. L'uso civile riprese solo nel 1979 e il sito fu prescelto nel 1998 per diventare il futuro Museo Archeologico Nazionale della Laguna di Venezia. Dopo la dismissione del lazzaretto pubblico, alcuni edifici dell'antico complesso furono parzialmente o interamente demoliti e tutte le strutture subirono un significativo degrado a seguito del progressivo abbandono dell'isola. Nonostante la nuova funzione culturale prevista, gli sforzi di restauro sono attualmente ancora in atto, ostacolati nel corso dei decenni dalla persistente mancanza di finanziamenti.

Obiettivo di questa tesi è lo studio dell'organizzazione spaziale del Lazzaretto Vecchio nel corso dei secoli, a partire da una serie di fonti storico-documentarie, archivistiche e iconografiche, al fine di stabilire una cronologia dettagliata delle trasformazioni architettoniche di questo sito. Nello specifico questo studio si avvale anche di una serie di strumenti digitali per lo studio, l'analisi strutturale e la ricostruzione della fabbrica nota come Generalato, edificio originariamente sede del convento dei frati agostiniani e successivamente adattato per ospitare e curare illustri ufficiali e diplomatici della Repubblica di Venezia.

Questo lavoro mira a far luce sulle caratteristiche architettoniche, formali e costruttive del Generalato prima della sua parziale demolizione intorno alla metà del XIX secolo, integrando i dati raccolti da rilievi in situ con le ricerche storiografiche. Sono state inoltre condotte indagini sui diversi meccanismi di degrado che interessano le strutture superstiti del Generalato, presentando alcune proposte per studi futuri da condurre prima del restauro dell'edificio, con l'obiettivo di fornire preziose informazioni sul processo di recupero della struttura.

Questa tesi multidisciplinare integra Sistemi Informativi Geografici Storici (HGIS), Software di Progettazione Assistita da Computer (CAD) e di modellazione 3D per l'elaborazione dei dati, la digitalizzazione, l'interpretazione e la visualizzazione di una struttura di grande importanza storica ma profondamente alterata dalla mano dell'uomo e dal tempo. Attraverso queste metodologie, lo studio non si limita a documentare lo stato di fatto dell'edificio ma presenta anche una ricostruzione critica delle sue fasi storiche e delle sue trasformazioni nel tempo. La ricostruzione virtuale frutto di

questo elaborato si presenta come uno strumento innovativo ed efficace per la conservazione, la valorizzazione e la divulgazione del patrimonio costruito. Permettendo una comprensione più completa degli aspetti materiali e immateriali del sito, questo approccio contribuisce al più ampio dibattito sulla storia dell'architettura veneziana e non solo e offre nuove prospettive sul paesaggio culturale e storico della laguna di Venezia.

Parole chiavi: Venezia; Architettura; Ricostruzione; Digitalizzazione.

Introduction

The Republic of Venice, known as the Serenissima, had its history marked by the Black Death—one of the most devastating epidemics caused by the spread of the bubonic plague. Amongst the series of measures implemented by the Venetian government to combat the plague outbreak was the establishment of permanent health structures on the lagoon islands, implementing a system of isolation for infected patients and goods. This initiative started with the repurposing of the former Giamboniti monastery and the Church of Santa Maria di Nazareth, which would later be known as the Lazzaretto Vecchio, the first institution of its kind in the world.

The Lazzaretto Vecchio complex, selected to serve as a facility for the prevention and treatment of the plague due to the island's strategic location, stands as a testament to the resilience of architectural and landscape spaces and their capacity to endure and adapt to evolving societal needs, with particular significance attributed to the expansion efforts carried out during the early modern period, which include land reclamation and several construction works. From a religious community centre to a health apparatus, the island assumed yet another role in the 19th century, during Austrian domination, marking a further shift in the existing structures' function. Lastly, following decades of abandonment, the site has been designated for the establishment of the National Archaeological Museum of the Venice Lagoon—deeming the recovery and restoration of the remaining buildings as urgent.

The spatial organisation and architectural development of the Lazzaretto Vecchio have not been investigated as extensively as might be expected, given the site's considerable historical and cultural significance. For this reason, this thesis seeks to undertake the challenge of reconstructing the island's chronology by drawing upon a range of diverse available written and iconographical sources, with a focus on the former Giamboniti dwelling, later known as the Generalato—the oldest surviving structure on the island. Furthermore, the study incorporates meticulous and precise data, gathered through *in situ* surveys, to illustrate the sequences of events and modifications that have shaped the building's current form and state of degradation.

With the aid of multiple modern technologies, this research promotes digitalisation as a tool for the comprehensive documentation, investigation, and recovery of built heritage, addressing the challenges of significant anthropogenic transformations and time-related deterioration.

1. History of the Lazzaretto Vecchio island

1.1. THE MONASTERY OF SANTA MARIA DI NAZARETH

Located approximately 60 metres from its most southeasternmost point to the Lido, near the inlets of Malamocco and San Nicolò, the island of Lazzaretto Vecchio covers an area of 2.53 hectares, with 8,500 square metres of built space, and lies roughly three kilometres from the city of Venice (Fig. 1). Its position holds historical and strategic significance, derived from the proximity of the island to the principal maritime routes of the Adriatic Sea, especially the inlet of San Nicolò, which served as one of the main waterways into the Venetian Lagoon.

The island's initial settlement was established in the first half of the 13th century by one of the many monastic communities that inhabited the lagoon: the hermit monks known as the Giamboniti or Zambonini, followers of Beato Giovanni Bono. It served as both a secluded place for prayer and a waypoint for pilgrims traveling to or from the Holy Land, the region between the Mediterranean Sea and the Jordan River (Corner, 1758, p. 299).

Christian monasticism has its roots in Egypt and the Middle East, during the Late Antique period, in the mid-3rd century BC. It had its development in Italy in the following centuries, largely due to the popularity of Benedetto da Norcia, known as St. Benedict, founder of the rule of monks attributed to him. The Order of St. Benedict reached Venice in the 8th century, circa 724, with the foundation of San Michele Arcangelo in Brondolo, the first monastery in the Venetian Lagoon (Pozza, 1996, p. 17).

The Giamboniti doctrine began spreading in 1217, when its founder—also known as Giambono or Zanibono—gathered his first disciples in the region of Emilia Romagna. These early followers adhered to the Augustinian Rule. By 1238, Giamboniti friars had arrived in the Veneto region, a few years before their congregation was officially recognised by Pope Innocent IV in 1246. On April 9, 1256, Pope Alexander IV formally integrated them into the Mendicant Order of St. Augustine, whose principles derived from the rule of the Bishop of Hippo (Dal Pino, 1997, p. 57).

Although little direct evidence remains of their early presence on the island, historical records confirm that in 1249, the Bishop of Castello, Pietro Pino, consecrated its first stone, laying the foundation of a church dedicated to God and the Virgin Mary, named Santa Maria di Nazareth. However, it is believed that some of the friars had already settled there before this date, likely residing in temporary lodges—an hypothesis supported by geological and archaeological findings. An

excavation conducted in 1998 by the Diego Malvestio company, under the coordination of Dr. Valle and as part of a scientific investigation led by the Superintendence for Archaeological Heritage of Veneto, dated the salt marsh beneath the church of Santa Maria to the 11th century, the oldest nucleus of the island (Tiozzo, 2000-2001, p. 41).

The hermitic lifestyle of the order required seclusion, and solitude was ensured by the use of monastic cells as individual living spaces. Other areas were designated for shared life (*vita communis*)—communal meals and prayer—by those practicing cenobitic monasticism. Augustinian friaries, similar to the Benedictines, were characterised by standardised layouts, typically centred around a cloister: an open courtyard surrounded by porticoed passageways that provided access to the church and other communal buildings. This function of connecting the main spaces of a monastery gives the cloister a mediating characteristic. Richard Irvine (2011, p. 42) highlights the cloister as an architectural element that served the *vita communis,* as it not only served as a gathering space for the monks, but also facilitated frequent interpersonal encounters and social interaction.

The church was considered to be the most important building in a monastic complex, serving as the spiritual heart and central place of worship for the community, and representing the "dwelling of God". For McNamara (2009, p. 8), the sacrality of architecture can be explained by design decisions that transmit theology through built form, even when expressed in a simple typology. This begins with the positioning and orientation of the sacred building longitudinally facing eastwards—*ad orientem*—with the main point of interest, the sanctuary with the altar, placed on the east end, within an apse. The importance of orientation derives from the early Christian custom of praying in the direction of the Holy Temple in Jerusalem, inherited from Jewish tradition (Lang, 2009, p. 36). Early Augustinian churches built in the 13th century, such as Santa Maria di Nazareth, would typically reflect the mendicant principles of the order through a simple and austere design: a single-nave plan, wooden ceilings, and unadorned façades.

The chapter house was another essential component of the monastery, usually located on the eastern wing of the cloister, near the church. It received its name from being the place where daily meetings were held, during which a chapter of the monastic rule was read aloud by the abbot—for this reason, the governing body of the community was also called "the Chapter". The chapter house also hosted gatherings where general affairs regarding communal life were discussed, such as duties' allocation and the keeping of business records. Matters related to the discipline of the community were addressed and resolved in this space as well.

The refectory, or dining hall, served as the central space where friars gathered for meals. Usually built in a rectangular layout, it featured elongated tables arranged in single rows parallel to the walls, allowing an organised and silent dining experience. The refectory was commonly situated along the southern or western wing of the cloister, depending on the overall layout of the monastery. According to monastic tradition, a lectern or pulpit stood within the hall, from which a designated friar would read scripture or hagiographical texts during meals. Adjacent to the refectory, for reasons of practicality and functionality, was the kitchen, a key component of the monastic complex, where food was prepared for the community.

Despite the lack of historical sources confirming their precise location, it is likely that the Giamboniti complex of Santa Maria di Nazareth was organised with the aforementioned spaces—which commonly formed part of an Augustinian monastery—on the southernmost area of the island, to the right of the church. Over the centuries, these structures were later adapted for the island's new healthcare and military functions.

Historical records of bequests provide evidence of activities associated with the church of Santa Maria di Nazareth and its community. The earliest known donation, dated 1251, was made by Isabetta, wife of the Marchesino da Muggia, benefiting the hermits of Murano, Sant'Anna di Castello, Santa Maria di Nazareth and Sant'Erasmo. Further bequests followed: in 1253 from Marco Ziani, and in 1256 by Widiota, widow of Enrico Dal Molin, both supporting monasteries including Sant'Erasmo, Santa Maria di Nazareth, and Sant'Anna. In 1275, the executor of Daniel Barbeta's will, Marco Venier, assigned Barbeta's houses in Sant'Angelo to the hermits of Santa Maria di Nazareth, who later relocated to the *sestiere* of San Marco. This transfer marked a partial and gradual decline of the monastery, though its community persisted throughout the 14th century until its full suppression in 1436 (Busato, 2006, p. 115; Caniato, 1997, pp. 160-161).

1.2. REPURPOSING THE ISLAND INTO THE WORLD'S FIRST LAZARETTO

As one of Europe's main centres of navigation and trade, Venice suffered repeated outbreaks of bubonic plague, beginning in 1348, exacerbated by its role as a major commercial hub in the Mediterranean. The Black Death, described by Langer (1964, p. 114) as the worst disaster ever to befall mankind, led to the initial measure of burying the bodies outside of the city. This was deemed necessary to avoid the corruption of the air, which was considered the main cause of plague transmission. Following the 14th century epidemics, the islands of San Leonardo Fossamala and San Marco Boccalama—both nowadays submerged—were chosen as burial grounds. These islands became overcrowded with corpses after just two months, forcing the leaders of the *sestieri* to also use

the islands of Sant'Erasmo and San Martino di Strada for burials. This required a series of instructions regarding the placement and covering of graves with sand and earth to avoid the release of odours (Venice, State Archives, *Maggior Consiglio, Spiritus*, c. 155v, the 3rd of April, 1348, and c. 156, the 5th of June, 1348; Busato, 2006, pp. 161-162; Mueller, 1979, pp. 77-78).

A violent outbreak of contagion in May 1423 prompted Doge Francesco Foscari, a skilled administrator experienced through his service in the office of the Procurators of St Mark's (*Procuratori di San Marco*), to promote a series of urgent solutions to systematically and permanently protect the city from the epidemic. Doge Foscari, who had lost four of his children to the plague, commissioned the *Signori di notte*—magistrates in the Serenissima in charge of repressing crimes and monitoring nocturnal activities—to keep a daily count of plague-related deaths, and keep the *Signoria* informed. By the end of August, when the mortality rate reached forty victims per day, the Doge presented a resolution to the Senate, prohibiting the entry of foreigners coming from infected places into the city. He also proposed the establishment of a hospital to isolate and treat plague victims from the city, the islands, and boats arriving at the port. The *Signoria* was authorised by the Doge to spend 1,000-2,000 ducats for the construction of the hospital—on the Lido or elsewhere unspecified—equipped with at least twenty rooms (Corner, 1789, p. 300; Vanzan Marchini, 2004, p. 19; *Venezia e la peste,* 1979, p. 84).

On August 28, 1423, a decree was issued to establish the new hospital, creating the first quarantine centre in the Mediterranean—and perhaps the first structure of its kind in the world—for preventing the spread of the plague. In October of the same year, on the advice of the Franciscan preacher San Bernardino, who stressed the need for a spacious and remote location after having served in the plague hospital in Siena during the epidemic of 1400, the Venetian Senate decided to convert the island housing the church of Santa Maria di Nazareth and the Augustinian monastery into a healthcare facility to accommodate people and goods arriving from plague-infected regions (Passante, 2020, p. 8; Stevens Crawshaw, 2012, pp. 3 and 40; *Venezia e la peste*, 1979, A. 7, p. 365).

The island was strategically chosen due to its location: not too far from the city centre, and near the main inlets that lead into the city of Venice. San Nicolò del Lido, a primary naval access point, was a key entry for international travellers arriving to the capital and, therefore, the primary route for potential infection. Moreover, the site complied with a 1347 decree prohibiting the construction of hospitals within the city's urban fabric, a policy that effectively isolated the sick and poor by only allowing new health facilities to be built on the islands (Passante, 2020, p. 8; Vanzan Marchini, 2004, pp. 21-22; *Venezia e la peste*, 1979, pp. 84-85).

Figure 1. Satellite image of the Venetian lagoon, highlighting the location of the Lazzaretto Vecchio island (Robert Simmon, NASA's Earth Observatory, 2001).

The model of isolation implemented on the Lazzaretto Vecchio, although similar to the principle of a leper colony established in 1262 in the island of San Lazzaro (later known as San Lazzaro degli Armeni)—used to quarantine patients affected by leprosy—that kept the sick isolated by both walls and the water, is a further development of the rich tradition of the complex Venetian charitable and healthcare system, established in both the city centre and throughout the lagoon. According to Preto (1979, p. 125), Venice was characterised by the "presence of a rational and orderly intervention by the state apparatus," and utilised its unique and flexible territory as an advantage to immediately counteract the emergencies, establishing institutions on the margins of the urban fabric to combat diseases. Confinement was one of the first welfare measurements adopted by the Serenissima, and along with quarantine, is described by Stevens Crawshaw (2012) as "the policy at the heart of public health for the plague" (Galeazzo, 2021, pp. 49-50; Stevens Crawshaw, 2012, p. 7).

The first name of the new healthcare centre established in the island of Santa Maria di Nazareth likely derived from the name of the former church: *nazareto* or *nazarethum*, later corrupted

to *lazaretum* or *lazzaretto*. The similarity between the term *lazzaretto* and the name Lazzaro is most likely related to the geographical proximity of the two islands. Additionally, it may also have resulted from a misinterpretation by people coming to the *lazaretto* from outside: the island of San Lazzaro served as a location to transfer the sick when the Lazzaretto Vecchio became overcrowded, due to practical convenience, given the presence of the old leper hospital (Passante, 2020, p. 8; Stevens Crawshaw, 2012, p. 20).

The former monastic structure enabled the hospital to begin healthcare activities almost immediately with minimal expenses: the existing individual rooms once used by the friars were easily repurposed as separate quarantine units for each patient. By January 1424, the hospital was fully operational, as documented by the local office of the *Magistrato al Sal*. Part of the cloisters of the earlier monastery were adapted for hospital use, as well as the small cemetery within the walls, which had most likely been built earlier by the hermit monks.

From the outset, however, the Lazzaretto's capacity appeared limited in relation to the number of infected patients. For this reason, in 1429, a donation from the Major Council allowed for the construction of eighty additional rooms, expanding the complex. During the hospital's early years, architectural interventions were limited to small-scale projects, and some of the Giamboniti continued to live and work at the facility. Initially, the island remained under the spiritual jurisdiction of the hermit friars, who were responsible for carrying out charitable works and overseeing the assistance provided by other religious figures from different orders who joined the state-paid personnel, helping to meet the large demand for care and administration of sacraments. In 1430, the Major Council requested suppression from Pope Eugene IV, who ended the monastery's activities in 1436 (Venice, State Archives, *Magistrato al Sal*, Serie I, reg. 8, c. 48, the 12th of January, 1423, *m.v.*; Crovato, 1979-1980, pp. 76-127; Palmer, 1979, p. 104).

A new decree was issued in 1431 to increase funding for the Lazzaretto's maintenance. One year later, the Council of Ten instructed notaries that all the testators should be asked to provide a contribution for Santa Maria di Nazareth, turning the Lazzaretto into one of the *loci pii*—pious institutions—of the city. From that moment onwards, the hospital became financially autonomous, later receiving additional support from the Procurators of St Mark's, the administrators of the Doge's funds (Passante, 2020, p. 8; Stevens Crawshaw, 2012, pp. 18, and 61-62; *Venezia e la peste*, 1979, A. 7, p. 365).

A second state-funded lazaretto, called Lazzaretto Nuovo, to distinguish it from the first, was established in 1468 near Sant'Erasmo, on an island known as "Vigna Murata" (walled vineyard),

owned by the friars of San Giorgio Maggiore. Within the structured healthcare system established by the Serenissima, the two islands designated as permanent lazarettos served distinct functions. While the Lazzaretto Vecchio housed individuals already infected with the plague, this new facility was dedicated to quarantining people and goods, especially those arriving from the Levant, to prevent the disease from spreading into the city. The term used for this practice was the Venetian word *contumacia*. Recovering patients could also be transferred to the Lazzaretto Nuovo before being reintegrated into society. Vanzan Marchini (2004, pp. 26-27) describes the activation of the new hospital as a physical testimony to the population of the possibility of healing, but above all, as a guarantee to the continuation of Venice's mercantile activities with the entire Mediterranean, reconciling the interests of market and public health. Meanwhile, the Lazzaretto Vecchio continued to operate, fulfilling the distinct function of treating the infected people and keeping them isolated (Caniato, 2022, p. 50; Fazzini, 2004, pp. 12; Passante, 2020, p. 9).

Figure 2. G. Braun, F. Hogenberg, Venetia, from the *Civitates orbis terrarum*, 1612, plate 43, with the detail of the two lazarettos (Venice, Marciana National Library, 211.c.4).

While the Serenissima benefited from a widespread, well-structured, and highly adaptable territorial system, it also established an advanced technical and bureaucratic apparatus. In 1486, the Republic of Venice established a new judiciary body, the *Provveditori alla Sanità* (Magistracy of Health), to severely and effectively oversee public hygiene across the State. Its responsibilities included controlling carriers, protecting citizens, and providing treatment to infected travellers. The

island of the Lazzaretto Vecchio fell under the jurisdiction of this newly established magistracy, but its day-to-day management was overseen by a Prior and a Prioress, usually a married couple. They were initially elected by the local office of the *Provveditori al Sal*, and then by the *Provveditori alla Sanità*, following strict regulations on hospital procedures. While these rules were aimed to prevent fraud and negligence toward the sick and deceased, historical records reveal numerous instances of corruption episodes committed by Priors and Prioresses over the centuries (Passante, 2020, p. 9).

Scientific understanding of the plague only emerged in the late 19th century. During earlier epidemics, the plague was commonly interpreted by the public as a divine punishment. However, in 1546, the Italian physician Girolamo Fracastoro proposed that contagion occurred through three main pathways: direct contact, contaminated goods, and airborne transmission. Despite the actual causes of the plague being unknown at the time, doctors widely agreed that the immediate danger lay in the quality of the air. Consequently, improving air circulation in buildings was believed to enhance patients' health and mitigate the disease (Palmer, 1978, pp. 10-11; Passante, 2020, p. 9; Stevens Crawshaw, 2012, p. 28).

The expansion of the Lazzaretto Vecchio and the construction of new buildings occurred gradually, without a pre-ordained plan. Additions were made individually and irregularly over time, disconnected from each other, and responding to increasing demand and dictated by functional needs, so much so that architect Bernardino Maccaruzzi described the resulting layout as "badly arranged" in a report to the Magistracy of Health in August 1775. Even in their final configurations, both lazarettos presented a rather basic layout, with buildings occupying nearly the entire available surface. The interior spaces were divided into closed sectors, known as *contumacia* units, allowing each quarantine cycle to occur separately (Caniato, 2022, p. 55; Morachiello, 1991, p. 824; Passante, 2020, p. 9).

Medical opinions on the efficacy of the Venetian lazarettos were controversial long before contemporary times. In the 16th century, physician Leonardo Fioravanti published a plague treatise in which he argued that patients should be treated in their own homes, under regular medical supervision, rather than being sent to these so-called "frightening places." Similarly, the physician Girolamo Donzellini claimed that only those unable to receive proper treatments at home should be sent to lazarettos, which should be structured into four distinct areas: one for the sick, one for suspected cases, one for recovered patients, and one for those completing the quarantine period. By the 17th century, Health Officers recognised how the structure of the lazarettos could worsen infection conditions, as diseases spread quickly in the small, enclosed spaces of the islands. However, they still

favoured isolating the sick rather than allowing them to remain within the city (Stevens Crawshaw, 2012, p. 180).

In 1576, Rocco Benedetti described the poor conditions of the Lazzaretto Vecchio as "Hell on earth," with unbearable stench and odor coming from every side, continuous groans and sighs, and clouds of smoke from the burning of corpses. Some patients, driven to madness by the disease, would furiously leave the rooms and throw themselves into the water, or run to the gardens and be found bleeding among the thorns the next day (Benedetti, 1630, p. 17). On the other hand, Benedetti compared the Lazzaretto Nuovo to "a mere Purgatory," due to the lack of adequate supplies, and the depressed state of the patients. The issue of overcrowding of both lazarettos was emphasised by the author, who described 7,000-8,000 people in the Lazzaretto Vecchio's installations and "a good 10,000 persons" within the Lazzaretto Nuovo and its surroundings on the late 16th century (Stevens Crawshaw, 2012, pp. 52-53).

Periodic maintenance activities were undertaken on the 17th century, and documents attesting to the request of a thousand bed frames, later increased to two thousand, serve as evidence of the increase capacity of the Lazzaretto Vecchio, following the need to accommodate the sick wherever possible, probably in temporary wooden structures (Venice, State Archives, *Provveditori alla Sanità*, reg. 17, cc. 127r-133r; Preto, 1979, catalog card 145, p. 142).

The last epidemic of 1630-31 was the most deadly of the early modern period, killing around 40% of the overall population of Venice (Alfani *et al.,* 2019, p. 1192; Dalla Zuanna *et al.,* 2004, p. 35). The intensive use of the Lazzaretto Vecchio's facilities resulted in a consequent need for a general restoration intervention that took place in 1633-34. These works were not conclusive, as it is also documented that further reforms were planned in 1642 and 1643, and that the walls surrounding the island were restored in 1660—particularly a section that had collapsed into the canal (Venice, State Archives, *Procuratori di San Marco de Citra*, b. 361, fasc. D (6), the 20th of May, 1642, and the 15th of February, 1643; b. 362, q. A, 4 and 6 of March of 1660).

The eventual decrease in the number of patients following the final major outbreak transformed the island's functions: fewer patients were treated or isolated for preventive purposes, and the primary role of the complex shifted to carrying out hygienic prophylaxis operations on merchant cargoes. These procedures included air exposure and washing in running water, with each type of good following specific regulations.

1.3. THE DECLINE OF THE LAZZARETTO VECCHIO AND ITS AFTERMATH

The decline of the Lazzaretto Vecchio began in the 18th century. Contributing factors included the degradation of existing buildings, caused by the silting of the navigation channels around the island, and the swamping of the surrounding area, as attested in historical iconography from the period and, in particular, in Domenico Margutti's 1715 plan (Fig. 3). Meanwhile, a decrease in funds allocated for restoration exacerbated the situation. This financial shortfall stemmed from a recurring conflict of authority between the *Procuratori di San Marco de citra* and the *Provveditori alla Sanità*, regarding the administration of the finances of the island. The decline accelerated in 1782, when the Magistracy of Health decided to establish the Lazzaretto Nuovissimo on the island of Poveglia, near to the mouth of the port of Malamocco. Poveglia had already been used as a quarantine centre for plague patients since 1776, and by 1835, all health facilities were subsequently transferred there, marking the definitive closure of the Lazzaretto Vecchio (Passante, 2020, p. 11).

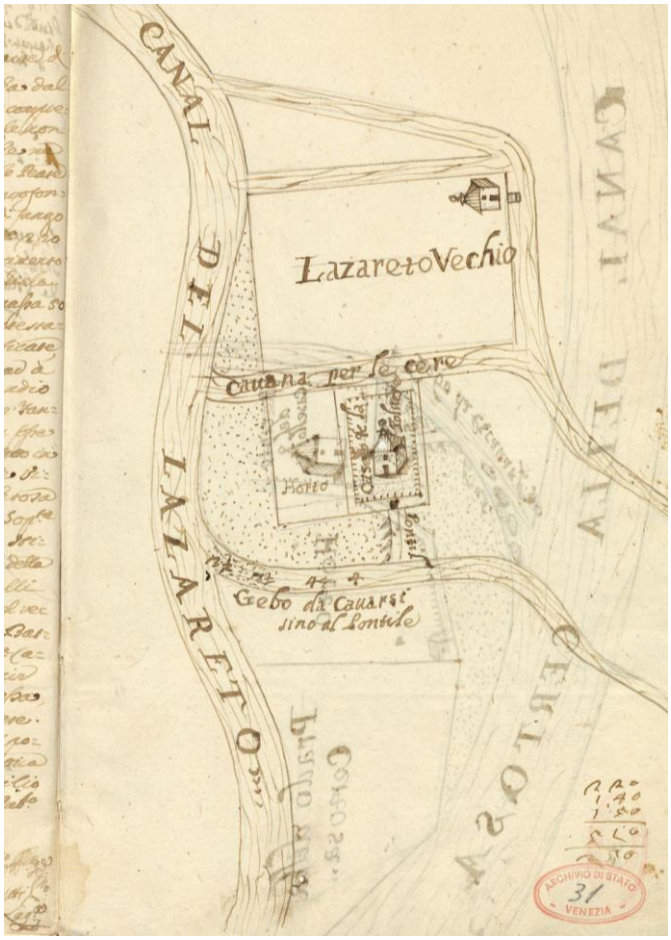

Figure 3. Domenico Margutti, Schematic map of the Lazzaretto Vecchio, annotated with details on the drainage and condition of the surrounding canals, 1715 (Venice, State Archives, *Savi ed esecutori alle acque*, *Atti*, b. 141, drawing no. 31).

The fall of the Serenissima Republic of Venice on May 12, 1797, marked a new era for the island. A Napoleonic decree in 1808 established that Venice would maintain only two lazarettos: the Lazzaretto Vecchio and the Lazzaretto Nuovissimo, while the Lazzaretto Nuovo was repurposed for military use, becoming part of the lagoon's defence system in the 19th century. After the islands were transformed into military sites, each lazaretto was overseen by a commander, a custodian, and a chaplain for religious services. However, in 1815, the island was handed over to the Austrian military command, and most of its buildings were converted into warehouses for storing gunpowder and military equipment. In the mid-19th century, restoration work at the Lazzaretto Vecchio focused solely on improving safety for those still working on the island. Buildings that were no longer safe or suitable for use were demolished. This function continued until 1967, under both the Kingdom of Italy and, later, the Italian Republic (Caniato, 2022, p. 56; Passante, 2020, pp. 11-12).

Efforts to demilitarise the island began in 1968, under the initiative of the Ministry of Finance, and were completed in 1979, when the Lazzaretto Vecchio passed from military to civil use. Following the departure of the military, various uses were proposed. In the late 1970s, a group of animal welfare volunteers was granted a lease to operate a temporary shelter for stray dogs, which remained active for about fifteen years (Crovato, 1978, p. 119).

In 1998, the site was designated for the future National Archaeological Museum of the Venice Lagoon. From 2004 to 2008, restoration efforts were carried out by the Ministry of Public Works and the Ministry of Cultural Heritage, with works managed by the Magistrato alle Acque and the Consorzio Venezia Nuova. However, due to the lack of funds, the project was suspended and activities were resumed only in September 2013, following an agreement between the Polo Museale del Veneto (formerly known as the Archaeological Superintendence of Veneto) and the Archeoclub of Venice, who provided free surveillance, guided tours, and minor maintenance across the island. With the Ministerial Decree of December 23, 2014, the Lazzaretto Vecchio was officially assigned to the Polo Museale del Veneto. In January 2020, the Ministry of Culture formalised the restoration project, reviving plans for the National Archaeological Museum of the Venice Lagoon (Crovato, 1978, p. 119; Passante, 2020, p. 12).

2. The architectural complex of the Lazzaretto Vecchio island

2.1. HISTORICAL SOURCES FOR THE STUDY OF THE LAZZARETTO VECCHIO

The task of interpreting the transformative history of the Lazzaretto Vecchio—as well as that of any other island of Venice's lagoon—largely depends on the availability of written and iconographical records, including paintings, drawings, engravings, and plans, as well as large-scale maps depicting extensive areas of the Venetian water basin. To reconstruct the layout of the Lazzaretto Vecchio island, hypotheses were formulated through a critical analysis that guided the interpretation of multiple types of sources.

Understanding the development of the island and the plague hospital requires a combined investigation of iconography produced in certain time spans—which, in the case of the Lazzaretto Vecchio, turns out to be extremely limited in the early centuries of its history—and the documented evidence preserved in historical archives. The Venice State Archives (*Archivio di Stato di Venezia* – ASVe) is of tremendous importance for the study of Venetian heritage, as it contains most of the historical sources of the Serenissima. Its archival materials, seminal for the elaboration of this thesis, include decrees, inventories, letters, wills, contracts, and reports, among others. The book *Venezia e la peste* (1979), published by the Municipality of Venice, compiles studies by 20th century scholars, as well as catalogs and a documentary appendix, making it a crucial source upon which this research is based.

As previously mentioned, cartography takes on a large role in observing the continuous change that shapes a territory. The Renaissance marked a new demand for topographical information, driven by a growing interest in the study of cities. Before 1490, only about thirty city views with geographically identifiable subjects existed; a century later, the number had increased so significantly that it became inestimable (Ballon *et al.,* 2013, p. 680). Atlas of cities were used by merchants and intellectuals to expand their knowledge of the world without the need to travel. The *Civitates Orbis Terrarum* (1572-1617), an editorial project coordinated by Georg Braun with the contribution of several artists (in particular drawings by Georg Hoefnagel and engravings by Franz Hogenberg), is an example of this 16th-century large production. It contained 546 views from different cities, Venice included (Fig. 2), with accompanying texts by Braun supplementing the visual information.

When discussing the portrayal of cities in early modern Europe, it is important to acknowledge the qualitative differences between manuscript maps and printed maps. Handmade maps were usually more rich in detail, as achieving intricate precision was easier through drawing than through carving. A formidable and monumental example of a woodcut print is Jacopo de' Barbari's *View of Venice* (fig. 4), first produced in 1500, which astonishingly—and accurately—displays a bird's-eye view of Venice and its surrounding lagoon islands. However, deformations and graphical mistakes even in this work of art serve as an early testament to the "iconographic pitfalls" that may arise when studying historical representations. This challenge underscores the importance of consulting multiple sources in order to achieve a well-grounded interpretation.

Figure 4. Jacopo de' Barbari, *View of Venice*, 1500 (Venice, Correr Museum, Cl. XLIV, n. 57).

Developed from the early 15th century until the late 17th century as a new cartographic and literary genre, the *isolarii*—books of islands—were cosmographic encyclopaedias of Mediterranean maps and represent one of the earliest sources for studying ancient sites in Venice. Benedetto Bordone's *Libro nel qual si ragiona di tutte l'isole del mondo*, published in 1528, marked an evolution of this genre and an expansion of its readership. In this work, Bordone covers a total of 111 islands, providing small-scale maps and indexes of the entire region. Among them is the archipelago of Venice, which includes the Lazzaretto Vecchio, presented as the first iconographical representation of this case study.

As Gerolamo Fazzini (2004) asserted, Bordone's portrayal of the Lazzaretto Vecchio as a large enclosure, though simplistic, effectively conveyed its identity as a space associated with illness and death. Despite its lack of precise accuracy, the image was not arbitrary. The high enclosing walls recalled a fortification, visually evoking the isolation needed to treat the plague patients. The series of chimneys most likely reflected one of the most striking architectural elements perceived by those who observed the Lazzaretto Vecchio on the boats from a distance: the existence of several individual rooms implied the need for chimneys for each one.

Figure 5. Benedetto Bordone, *Isolario,* 1528, with detail of the Lazzaretto Vecchio island (from B. Bordone, *Libro nel qual si ragiona di tutte l'isole del mondo*, Venice, Nicolò d'Aristotile detto Zoppino, 1528).

The maps produced by the *Savi ed esecutori alle acque* (Venice's water management office) are fundamental sources for the earliest iconographic representations of the Lazzaretto Vecchio, as they constitute the only existing visual documentation of the island. Although largely schematic, these maps—primarily concerned with hydrological features and the boundaries of the amphibious Venetian territory—often lack detailed depictions of individual buildings. However, they reveal concerns about the progressive silting of the canals and document the island's territorial expansion in various contexts.

From the 18th century onwards, several drawings by architects and surveyors envisioned new developments for the Lazzaretto Vecchio. Among these, the 1737 plan by Stefano Codroipo will be analysed in relation to the island's expansion. Additionally, a 1774 survey by Tommaso Scalfuroto, was of great importance for reconstructing the site's spatial layout, shedding light on the different phases of construction the island underwent. The work of English philanthropist John Howard, who studied European lazarettos and visited the Lazzaretto Vecchio in the late 18th century, provided further clarity regarding the definition and organisation of its spaces.

A particularly important source for this thesis, especially in relation to the digital reconstruction phase, is the 1813 map by engineer Vanzan Manocchi, an updated copy of a 1697 drawing by Giovanni Antonio Cornello, although the map incorrectly dates it to 1597 (Caniato, 2022, p. 54). This map offers detailed insights into the internal divisions of the buildings, aiding the understanding of the complex's functionality and organisation. Finally, 19th-century cadastral records and maps, produced during the island's military occupation, have been crucial for visualising the gradual demolitions that have led to the site's current configuration.

Vedutismo, a pictorial genre that emerged in the 18th century, is characterised by highly detailed, large-scale landscape paintings known as *vedute* (views). Venice became one of the protagonists of the *vedutismo* typology with the city's consecration as part of the itinerary of the Grand Tour, the traditional trip around Europe undertaken by young aristocratic men from the 17th to the 19th century, that had Italy as the main destination. Although Venetian *vedute* were not always accurate in terms of scale or spatial proportions—as painters often captured the view from a boat and could depict the scenario with intentional distortions to convey a message through the art—they remain valuable visual records in their description of the constituent elements of the portrayed sites. Francesco Zucchi, Francesco Guardi, and Antonio Visentini, some of the greatest practitioners of the genre, are authors of works of art portraying the Lazzaretto Vecchio.

2.2. THE ANCIENT GIAMBONITI BUILDINGS READAPTED AS A LAZARETTO: THE CHURCH AND MONASTERY

The church of Santa Maria di Nazareth and the Giamboniti monastery were the first structures built on the site by the friars in the 13th century. Excavations carried out in 1998 by the Superintendence of Environmental and Architectural Heritage of Venice uncovered the foundation walls and supporting palisades, providing valuable data for reconstructing the original layout of the church, which was demolished during the island's military use in the 19th century.

Figure 6. Photograph taken during the 1998 excavation, carried out by the Superintendence for Archaeological Heritage of Veneto, directed by Dr. De Min.

The church had a simple, single narrow nave plan with a rectangular emerging apse and lacked internal divisions. Its floor was made of *cocciopesto*, and tombs were opened and covered by marble slabs. The roof structure was most likely made of wooden trusses. This simplicity is not only likely associated with the peripheral site but also characteristic of places of worship associated with the mendicant orders. A bell tower, located on the north side of the church, near the apse, had a square base of about two meters per side. It featured a bell chamber with a single lancet window and two small decorative arches on each side (Passante, 2020, p. 16; Tiozzo, 2000-2001, pp. 44-45).

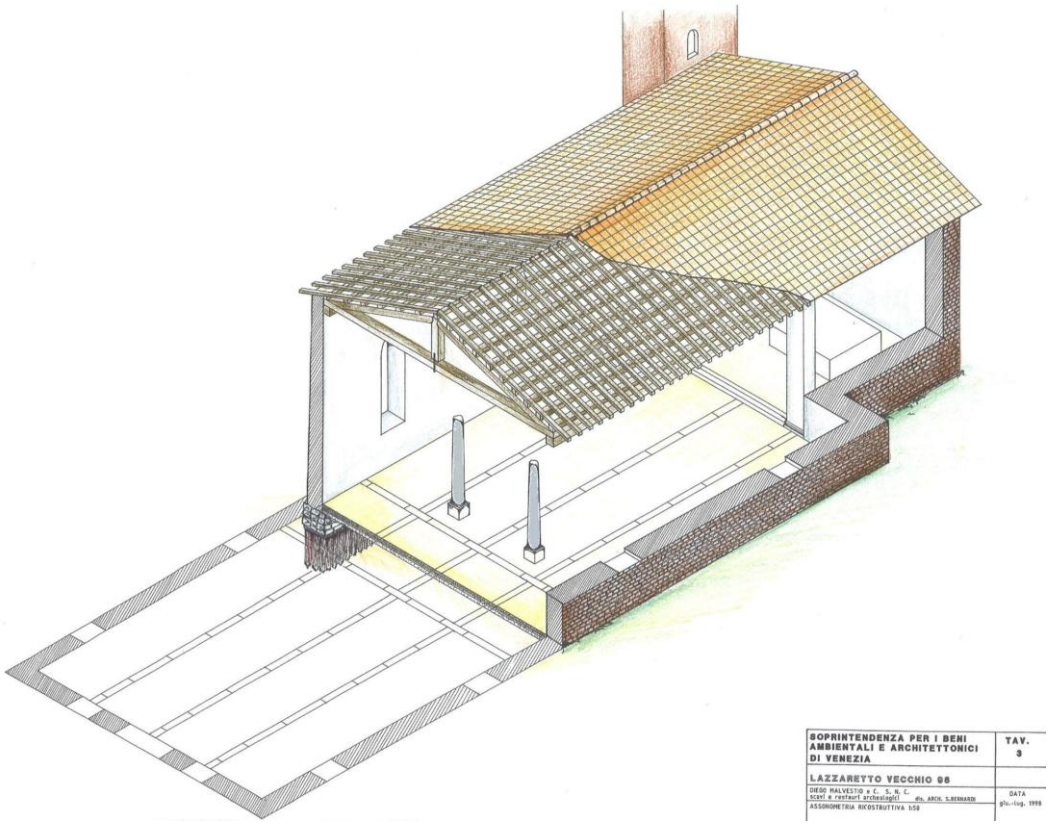

Figure 7. Diego Malvestio & C. snc, Axonometric reconstruction of the Church of Santa Maria di Nazareth, hypothesised from the findings of the 1998 excavation.

Annexed to the south façade of the church was the monastery and cloister of the Giamboniti. A 16th-century sketch drawing, made by one of the officials of the *Savi ed esecutori alle acque,* one of the first iconographic sources illustrating the religious complex, does not depict the monastery as a quadrangular structure. Rather, it shows a rectangular building extending from the western façade of the church, with a dock providing access. A second transverse building is placed at the termination of the church's apse, connected to a third longitudinal building on the south, parallel to the church (Fig. 8). The suggestion in this drawing that the monastery lacked a cloister seems implausible, given that documents from as early as 1548 refer to restoration work carried out in the cloister, thus confirming its existence at the time (Venice, State Archives, *Procuratori di San Marco*, *Misti*, b. 85, 1546-1561).

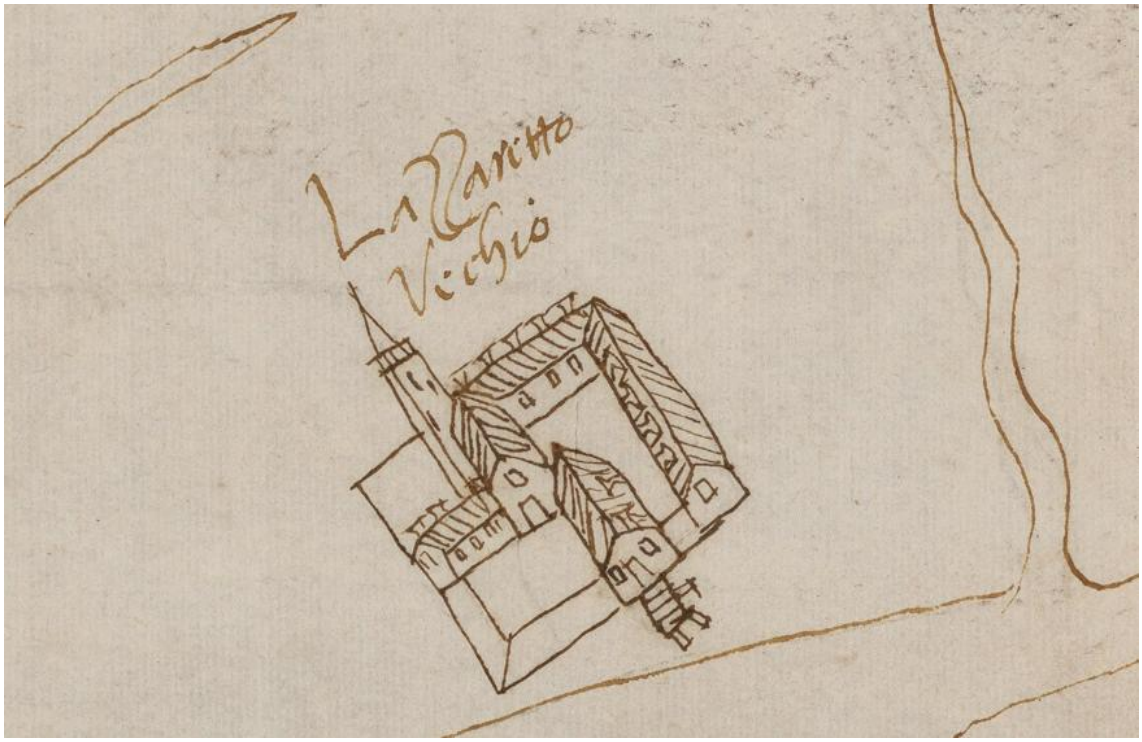

Figure 8. Cartography of the Lido and the Lazzaretto Vecchio, 1550 ca. (Venice, State Archives, *Savi ed esecutori alle acque, Disegni, Lidi*, roll no. 94, drawing no. 63).

Perspective views by Paolo Forlani (1566) and Georg Braun (1576) depicted the Lazzaretto Vecchio complex in a different arrangement. The monastery, a quadrilateral building, was not only detached from the church but also represented as larger in size. The church's façade is shown with three naves, with the bell tower and smaller adjacent buildings to the left. This inaccuracy is considered one of the challenges in this reconstructive work, and the historical source is used as a base for a more philological approach.

Figure 9. Georg Braun, Perspective plan of the city of Venice and the lagoons and parts, 1576, with the detail of the "Lazzaretto Vecchio Hospedal della Sanità", published by Paolo Forlani in 1566 (from *Venezia e la peste*, 1979, p. 10).

Accurate representations of the complex in the following centuries, such as the 1791 map by John Howard (Fig. 10), depict a central square cloister equipped with a well—a structure that can be traced back to the original layout.

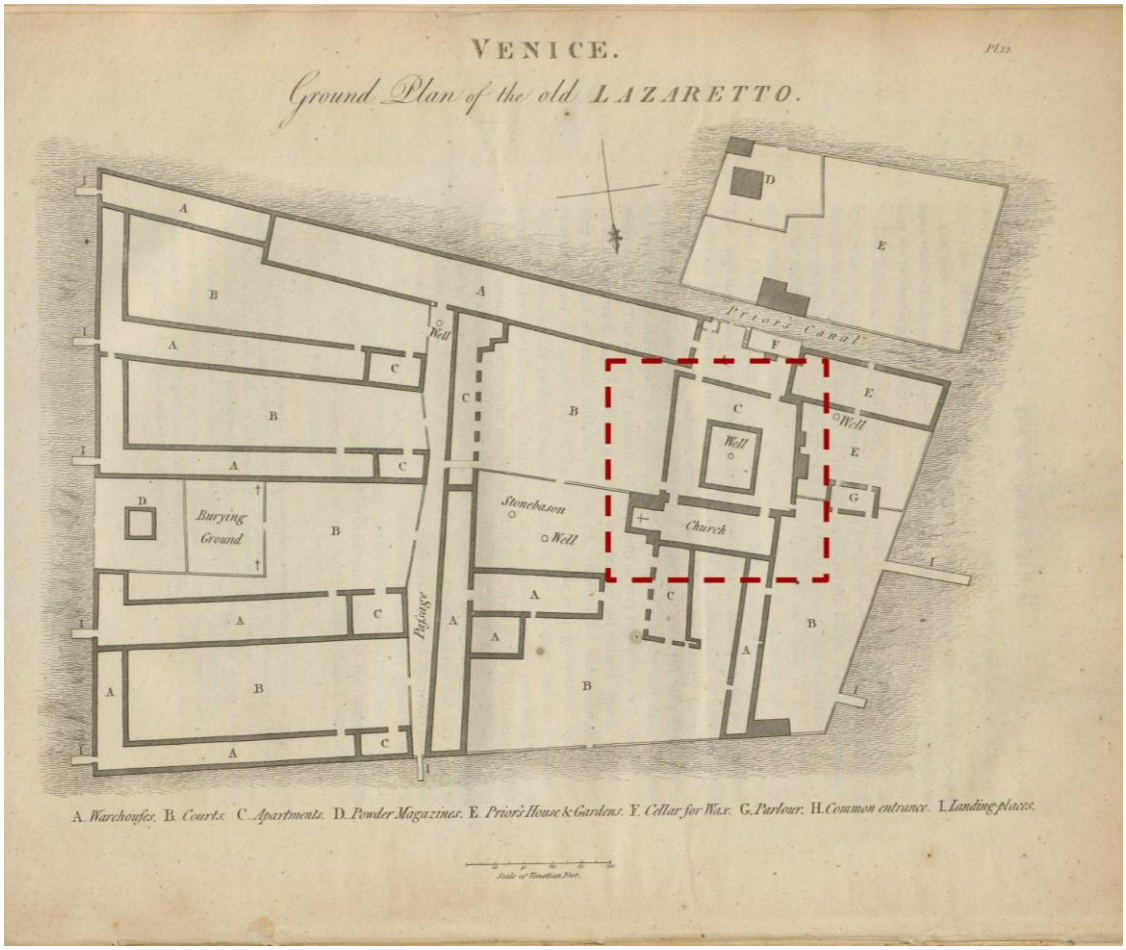

Figure 10. John Howard, Plan of the Lazzaretto Vecchio, 1791, with detail of the church and previous monastery structures (from J. Howard, *Ragguaglio de' principali lazzaretti in Europa, con varie carte relative alla peste*, Venice, Andrea Santini e Figlio, 1814, p. 10).

2.3. THE CONSTRUCTION OF THE QUARANTINE CENTRE AND EXPANSION OF THE ISLAND

The architectural complex of the Lazzaretto Vecchio underwent four distinct construction phases. The first phase, dating from 1423 to 1500, was characterised by the addition of wooden elements to complement the existing religious buildings, along with other temporary wooden structures primarily used for storage. A document from 1487 references a request for repairs on the "nazareto vecchio," mentioning the need for both a bricklayer and a carpenter—the latter most likely for mending doors and windows, as well as constructing shacks and sheds. The ephemeral nature of these wooden structures likely explains the constant need for repair interventions (Venice, State Archives, *Provveditori al Sal*, reg. 59, c. 127v.; Caniato, 1995, p. 436; Crovato, 1979-1980, p. 88).

Figure 11. Site plan of the Lazzaretto Vecchio island.

The Prior's house (*priorado*), a rectangular masonry building with two floors connected by three stairwells and a total of twelve rooms, was built between 1423 and 1478, on the southwest extremity of the island, following its first territorial expansion. It measures around 39 meters in length, and 12 meters in width. The ground floor was used as a warehouse, whereas the bedrooms for the Prior and assistants were located on the upper floor (Passante, 2020, p. 58).

Another building erected following the island's transition from monastery to quarantine centre was the Tezetta *(small warehouse)*. Located on the northwestern part of the island, this rectangular building measures approximately 38,5 meters in length and 7,5 in width. It was a typical Venetian *teza*, a construction structure used for the *contumacia* of goods, and it originally consisted of a single large room for this purpose. The building was fully porticoed on its western façade, and the open area between the Tezetta, the church, the Prior's residence, and the limit of the island was called "Prato della Tezzeta." The building underwent renovations in the 18th century, and a few later maps refer to it as Tezzetta Vecchia (Passante, 2020, p. 68).

The rapid initiation of the activities of the lazaretto, prompted by the urgency of the plague, was facilitated by the pre-existing religious complex on the island. However, the expansion of the Lazzaretto Vecchio, with eighty additional rooms in 1429, presents challenges in determining their precise placement. The absence of graphic representations makes it difficult to establish the position

of the new places in relation to the existing structures. However, it is likely that the monastic architecture, originally designed with individual rooms for friars, was repurposed to accommodate isolated patients. Nonetheless, the hospital's characteristics and capacity can be inferred from a 1484 inventory, which listed 209 beds and their associated supplies. Daily occupancy figures suggest that, between 1482 and 1486, the lazaretto housed approximately ninety people, assisted by thirty servants. In 1493, a restoration project was carried out under the direction of Bartolomeo Bon, commissioned by the *Magistrato al Sal*, to repair damage caused by deterioration (Caniato, 2022, p. 51; Crovato, 1979-1980, p. 88; Passante, 2020, pp. 8 and 64; Venice, State Archives, *Provveditori al Sal*, b. 293, c. 16).

Figure 12. Guglielmo Bergamasco, Bas-relief in Istrian stone, an ornament on the portal of the Contumacia alla Crozzola. It depicts Saint Mark and the saints Rocco and Sebastian invoked as protectors against epidemics. Dated 1525, it was commissioned by the *Procuratori di San Marco de citra* (Venice, Correr Museum, Cl. XXV, no. 148 and 149) (Mueller, 1979, pp. 88-89; Malagnini, 2018, pp. 94-96, Caniato, 2022, p. 51).

The second phase, spanning from 1520 to approximately 1587, is documented through archival records and stone inscriptions (Fig. 12). Constructions during the 16th century began in the southernmost part of the island: on the southwestern side, accommodations were built for the health personnel, while on the southeast, the largest building of the Lazzaretto Vecchio, the Tezon Vecchio, was erected in 1565. The still-existing Tezon Vecchio is a longitudinal masonry building measuring approximately 115 metres in length and 14 metres in width. It features three openings on its southern façade and two on the northern side, with a double-pitched tile roof. Its main entrance is located on

the western façade, while the eastern would later be connected via a doorway to the Tezetta al Pozzo, one of the *tezoni* (*contumacia* warehouses) built in the fourth phase (Passante, 2020, p. 10).

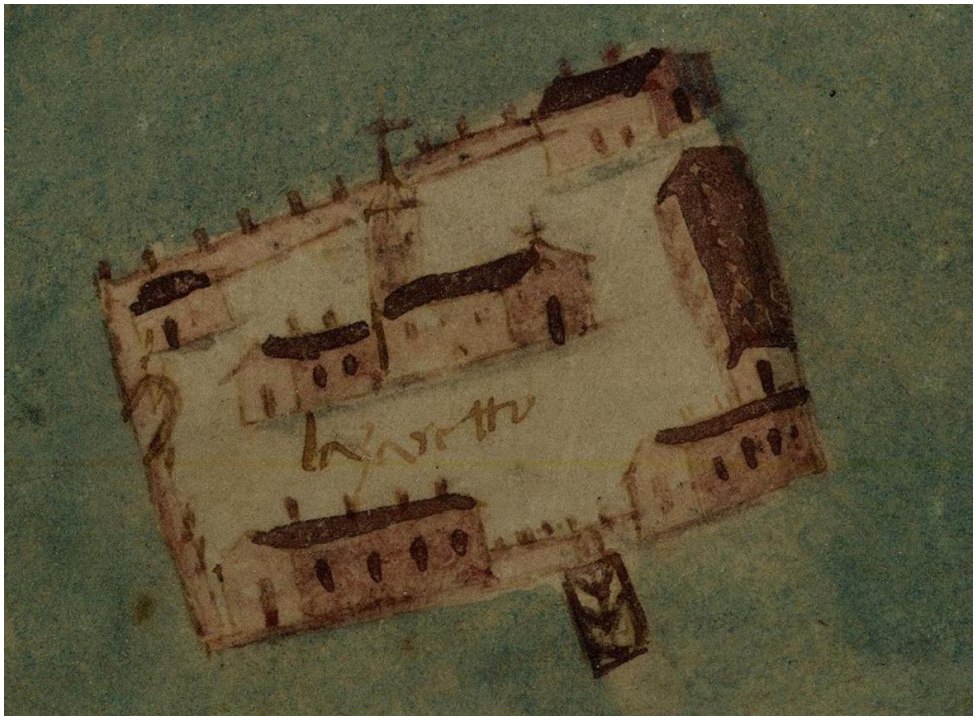

Figure 13. Domenico Gallo and Nicolò Dal Cortivo, Detail of the Lazzaretto Vecchio in a map representing the coastline of Malamocco, 1552 (Venice, State Archives, *Savi ed esecutori alle acque*, *Lidi*, drawing no. 5).

In 1520, the Teza alla Manega started being constructed as a readaptation of the primitive wooden huts and sheds from the first construction phase of the Lazzaretto. It was later rebuilt in the 16th century as a masonry structure with a rectangular plan, aligned with the perimeter wall of the island to the west of the church. Its existence is first attested in the 1552 map by Domenico Gallo and Nicolò Dal Cortivo (Fig. 13). In 1525, the Crozzola was built perpendicular to the Teza alla Manega, forming a cross-like shape that gave the building its name, even though a more accurate description would be T-shaped. The Cantinazza building was then constructed at the northern corner between the Teza alla Manega and the Crozzola, forming a complex known as the Contumacia alla Crozzola. Each of the three buildings had independent access, with doors connecting them internally (Passante, 2020, p. 71).

This construction phase marked a significant transformation in the island's nature, appearance, and organisational layout. The entrance, previously located on the western side, where the main façade of the church faced, was relocated to the southern side, accessible through the

Ortaglia—a small vegetable garden adjacent to the island, likely formed from landfill work carried out in the first half of the 16th century. In 1586, a *cavana* (houseboat shelter) was built between the Prior's house and the Tezon Vecchio in a bridge-like shape, with an almost square plan. The upper floor was designated for dwelling, with access through an external staircase on the northern façade. The organised open space between the *cavana,* the Prior's house and the Tezon Vecchio would be known as the "Corte del Priorato" (Passante, 2020, pp. 54 and 90).

The second construction phase also saw the island's expansion through the drainage of shallows and subsequent landfill works in the surrounding lagoon. This expansion is hypothesised to be linked to the construction of the Contumacia al Morer, an area to the east that, from 1564, was used as a cemetery due to the large number of dead. The Contumacia al Morer was originally built as a shelter for plague victims before burial: a two-floor rectangular structure with seven rooms on the ground floor and six on the first, attached to the Teza alla Manega to the north and the Tezon Vecchio to the south. On the ground floor, the Contumacia al Morer was divided by a *sottoportego*—a typical Venetian passageway—connecting two small rooms to the north and a staircase on the south (Caniato, 2022, p. 52; Passante, 2020, p. 80).

During this period, gunpowder houses became a functional necessity across the islands of the lagoon, starting in 1565. These cubic architectural structures, with pyramid-shaped roofs covered in stone, were built to store gunpowder. On the Lazzaretto Vecchio, one gunpowder house was located on the Ortaglia, and another was erected at the beginning of the 17th century on the eastern part of the island, near the cemetery. Both were later demolished in the 19th century (Panciera, 2006, p. 112-114; Galeazzo *et al.*, 2025, p. 1069; Passante, 2020, p. 10). These interventions appear to have been executed urgently due to functional needs, and the buildings were rapidly assembled with a temporary character. As a result, subsequent modifications and replacements were likely made in the later construction phases.

The third construction period, which occurred a few years after the last major plague epidemic in Venice (1630-31), focused on the restoration of existing buildings and the construction of new *tezoni,* long brick masonry warehouses, along the north, east, and south perimeters of the island. While the first two phases prioritised shelter and care for patients, often involving the creation of single rooms equipped with chimneys, from the third phase onward, greater attention was directed to the *contumacia* of goods. The *tezoni,* designed for this purpose, featured large openings to facilitate ventilation and air circulation. These structures, known collectively as *teze* and *maniche*, on an order from north to south were: Tezetta ai Morti, Tezone ai Morti, Manichetta ai Morti, Manica ai Morti, Tezone al Morone, Manica al Morone, Manica al Pozzo, Tezetta al Pozzo, covering a total surface

area of 2,355 square metres. The different nomenclature for the so-called *maniche* and *manichetta* (literally meaning "sleeves" and "small sleeve") reflects variations in size within this typology for isolation spaces, which were located adjacent to the island's eastern perimeter wall (Passante, 2020, pp. 11, 84).

The 17th and 18th centuries brought the most significant changes to the island, ultimately defining its final layout. The last two *tezoni*—the Tezone ai Morti and the Tezone al Pozzo—were built during the fourth construction phase, which lasted from 1730 to 1740. These buildings are documented in an expansion project by Stefano Codroipo (Fig. 14), where they can be identified among the pre-existing structures. Their design consisted of open canopies facing south, supported by pillars, with the northern façade enclosed. During this phase, the Lazzaretto Vecchio reached its peak in terms of the number of buildings on the island (Passante, 2020, p. 11).

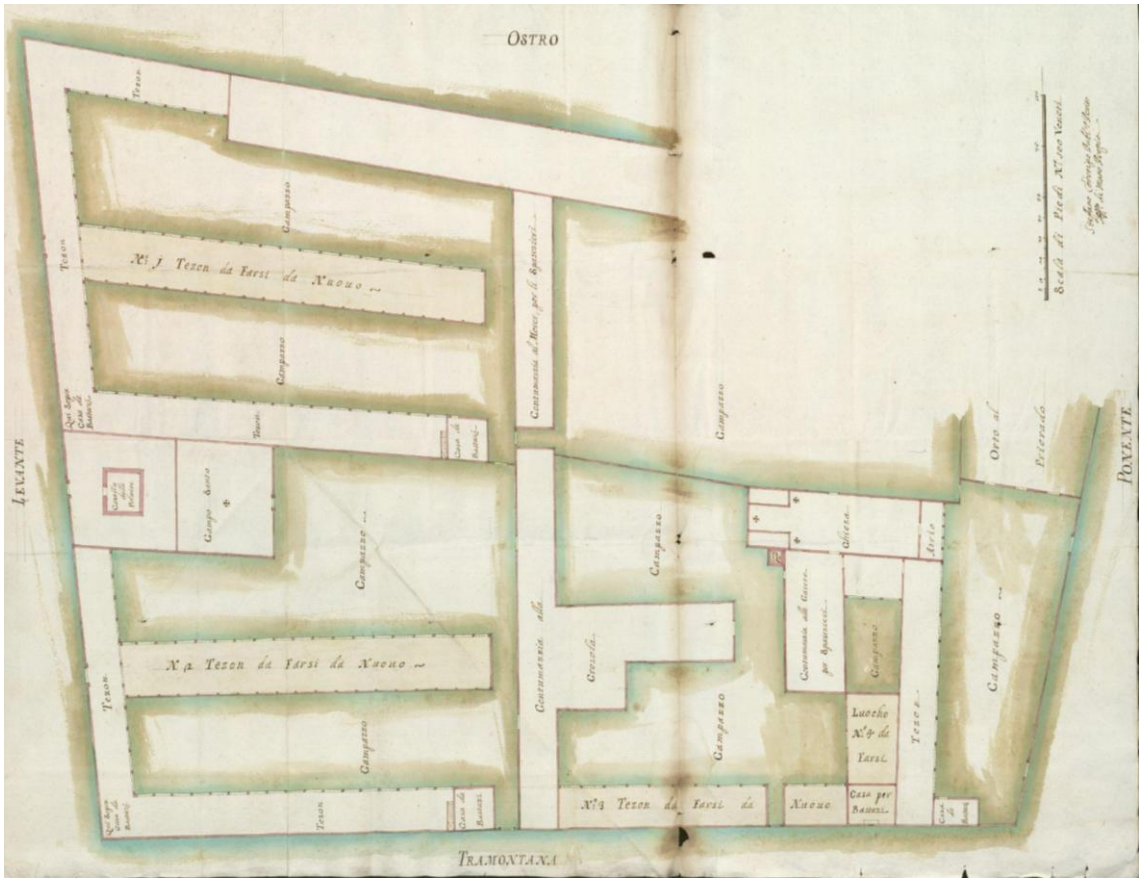

Figure 14. Stefano Codroipo, Map of the Lazzaretto Vecchio with a project for adding four new warehouses (*teze*), 1737 (Venice, State Archives, *Senato*, *Mar*, filza 974).

According to Bernardino Leoni Montanari's 1721 manuscript on administrative health matters overseen by the *Provveditori and Sopraprovveditori alla Sanità*, the Lazzaretto Vecchio's facilities are described in detail. The document outlines six sectors designated for accommodating 294 people and eight sectors allocated for the *contumacia* of infected goods, with the capacity of lodging 6,130 packages. Later, with the construction of the final *tezoni*, the facility's capacity was further increased (Passante, 2020, p. 11).

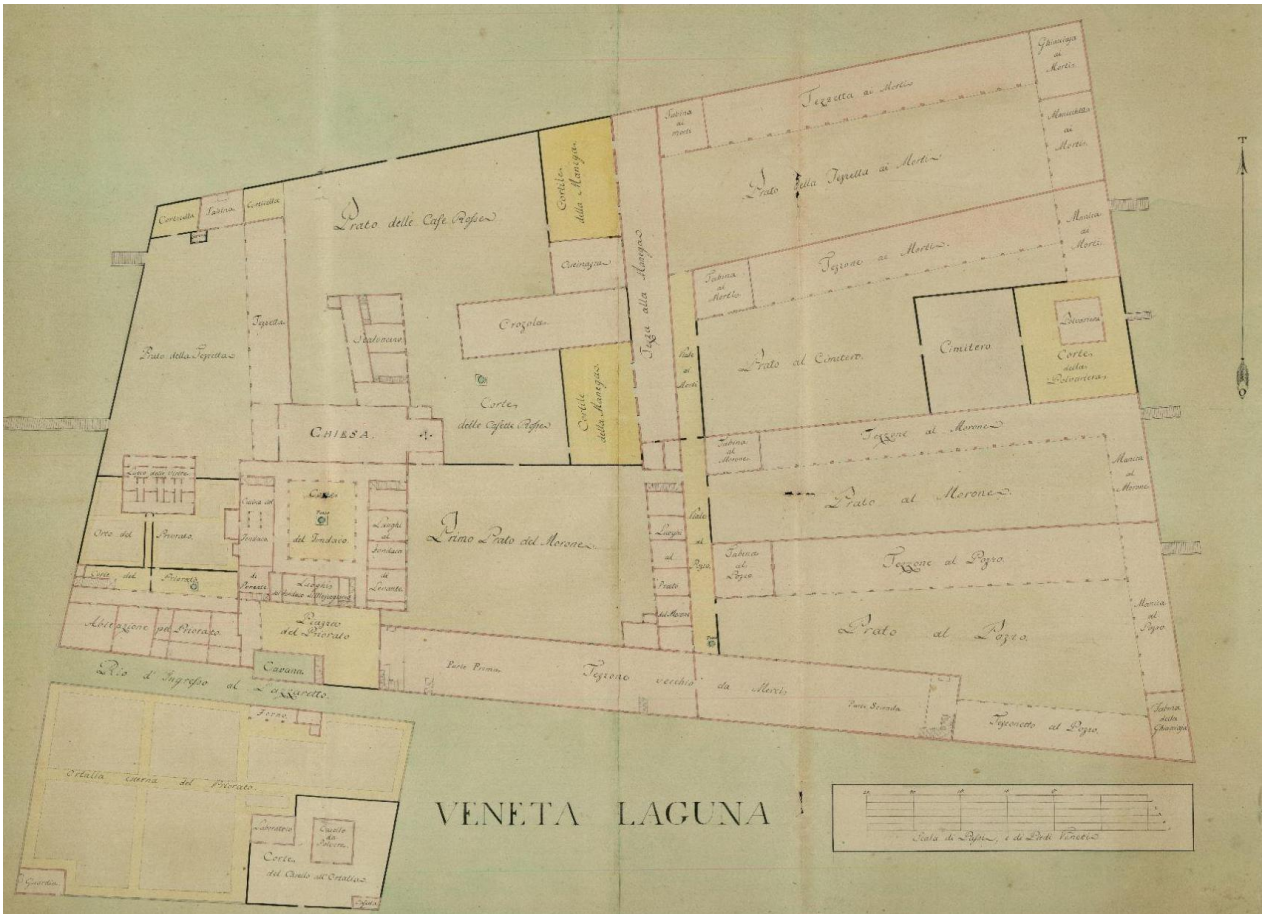

Figure 15. Vanzan Manocchi, Map of the Lazzaretto Vecchio, 1813 (Venice, State Archives, *I.R. Magistrato di sanità marittima,* b. 60, drawing no. 1).

The map by engineer Vanzan Manocchi (Fig. 15), an updated copy from an 16th-century map, depicts the structures of the Lazzaretto Vecchio during the Napoleonic era, suggesting the architecture of the complex did not change much over two centuries. This plan also highlights the so-called *tabine* at the extremities of the *tezoni*—the houses of the *bastazi,* the package handlers.

Under Austrian rule, the layout of the island and its buildings underwent modifications to meet logistical and functional needs. The church and its bell tower, remnants of the former monastery, as well as the gunpowder houses and workers' houses, were demolished. The *tezoni*, originally used for isolating merchandise with openings for ventilation, were sealed. Some structures, such as the Crozzola, were rebuilt, while others were modified for residential use (Passante, 2020, p. 12).

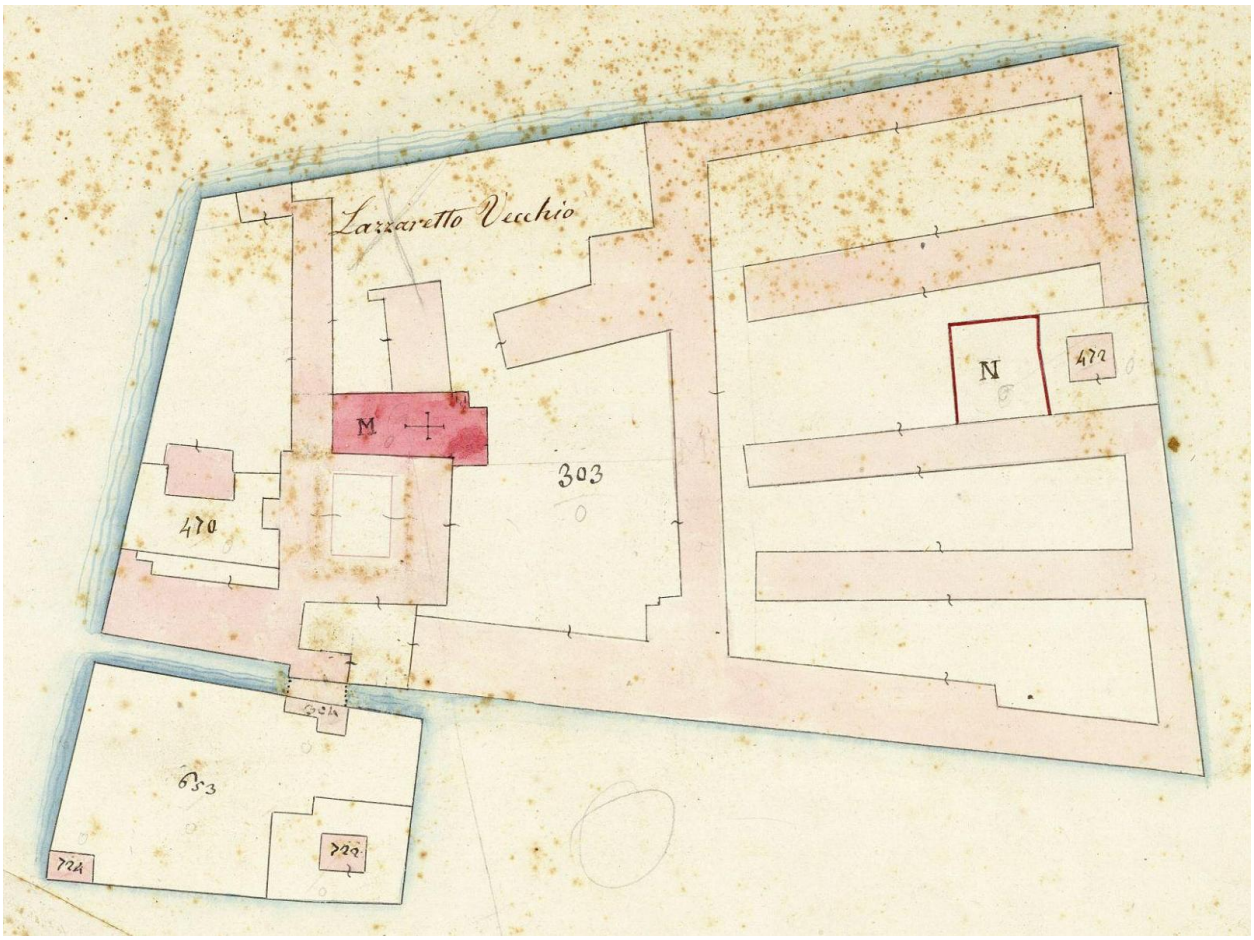

Figure 16. Austrian cadastral map, 1840 (Venice, State Archives, *Censo stabile*, *Mappe austriache*, *Giudecca e isole*, plate no. 10).

A valuable source for tracing the modifications made to the island during the military period is a plan found in the archives of the Military District of Padova (Fig. 17). This plan shows the bell tower without the church, raising questions regarding the functionality of this configuration. The demolition of the church could have caused significant structural instability, as the bell tower was a slender construction that was most likely physically connected to the ecclesiastical building, and could eventually rotate or collapse without the support of an adjacent structure. The military character

established on the island might have explained the need for a tall observation post, that could have been the reason for the persistence of the bell tower on the island before it was ultimately demolished.

The late 19th-century map also depicts the Crozzola and Tezon Vecchio (also referred to as Tezon Grande) repurposed as powder magazines. Another significant change, marking a turning point in the history of the island, is the reduction of the ancient monastery, later known as the Generalato, to two L-shaped wings. The reason behind the demolition of more than half of the original building remains unclear; however, it may reflect a need for available land in the central-western sector of the island, or it may have been prompted by the deteriorated condition of the structure following the church's demolition.

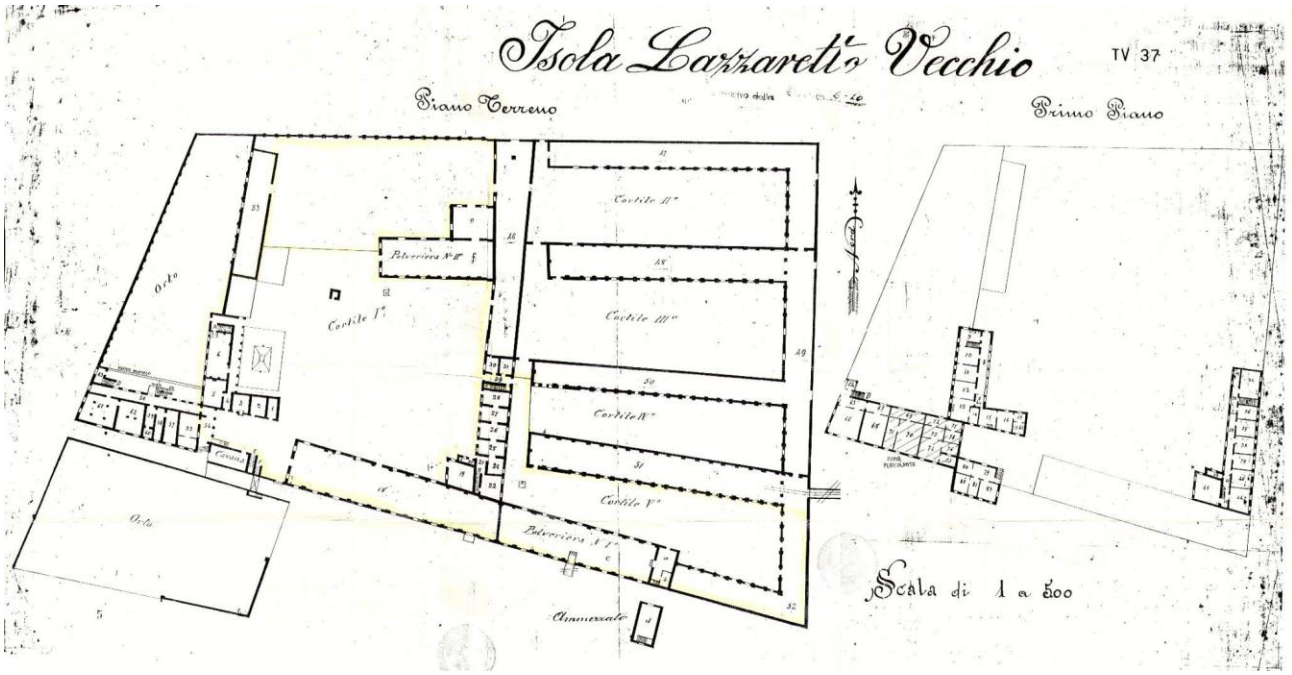

Figure 17. Survey of the Lazzaretto Vecchio, 1860-1870 (Padua, Archivio del Distretto Militare).

Figure 18. Picture of the bell tower and the Generalato in the late 19th century, after the demolition of the church and half of the ancient monastery, taken in 1889 (Correr Museum, inv. MCV-CF001345).

3. The Generalato

3.1. HISTORICAL CONTEXT

The Generalato, also referred to as the Bailato, received its name from the function it served after the monastery was converted into a quarantine centre. Although the entire island was repurposed as a lazaretto with the decree of 1423, it is unclear when the building began to be used exclusively to treat the prestigious officers and diplomats of Venice. The Generalato, previously the centre of the hermit community, became the place of contumacy for the *Baili* of Constantinople, the *Provveditori generali* (General Providers), and the Rectors who were to be quarantined upon their return from the Levant, attesting to the series of shifts in the use of this site's previously existing structures. The specific nature of its function is clearly indicated on a 1818 map (Fig. 19), which includes the inscriptions "Contumacia del Generalato" and "Contumacia al Fontego", denoting places of *contumacia* for the Generalato and the warehouse, respectively.

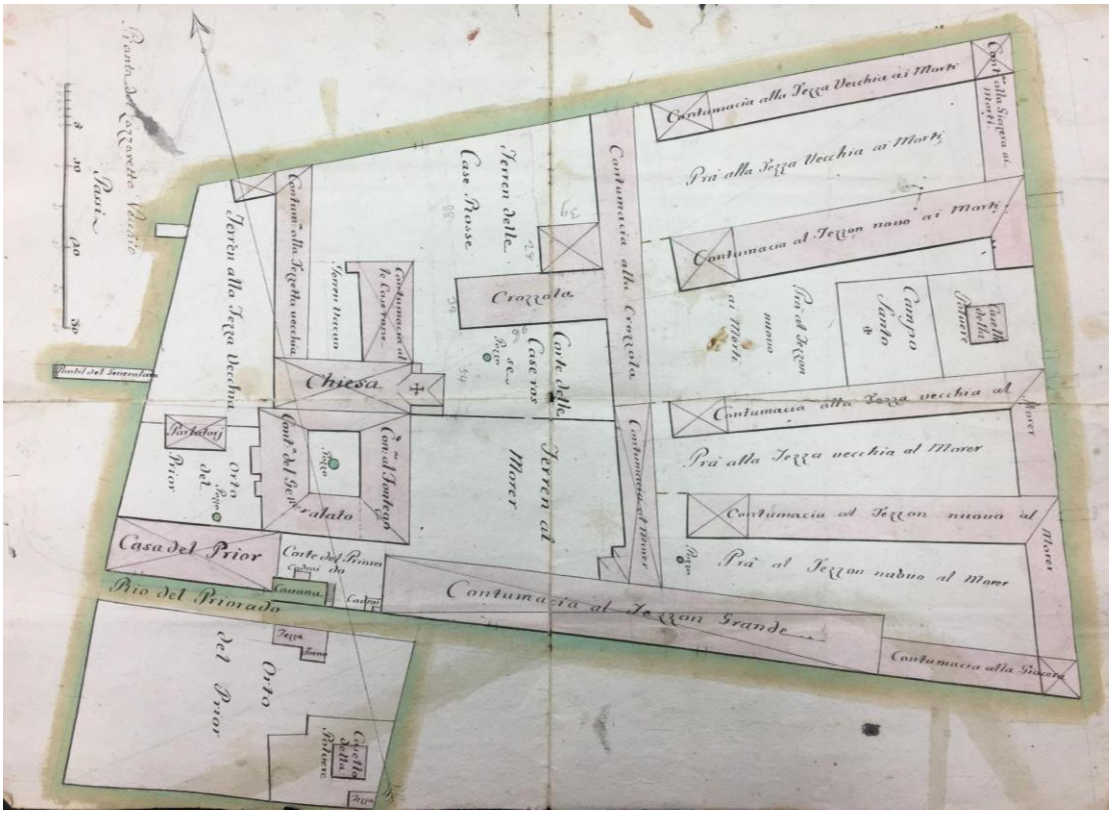

Figure 19. Map of the Lazzaretto Vecchio, 1818 (Venice, State Archives, *Ufficio provinciale delle pubbliche costruzioni*, b. 1313).

The administration of the Venetian dominions was entrusted to the Rectors, appointed either by the Republic or by the Venetian Councils. In some cases, Rectors were selected by the local community or by the feudal lords. In military zones, Rectors were referred to as local—or ordinary—*Provveditori,* typically subordinate to a *Provveditore generale*. The *Provveditori generali* were high-ranking officials of the Serenissima, responsible for the governance of a Venetian province or military district. Their roles and responsibilities were divided into various categories, such as: *Provveditore Generale da Mar*, the supreme commander of the Venetian navy during peacetime; *Provveditore Generale di Terraferma*, commander of mainland territories; and *Provveditore Generale delle Fortificazioni*, responsible for the construction and maintenance of fortresses (Da Mosto, 1940, pp. 3-5).

The *Bailo*—a term used for the chief Venetian diplomat in Constantinople—was responsible for overseeing the Republic's legal and trade affairs in the Ottoman capital. This position was first established in 1268, following the Treaty of 18 June 1265. After centuries of complex alliances and conflicts between Venice and the Byzantine and Ottoman Empires, the *Bailo* came to play a crucial role in protecting Venetian political interests and served as a consular representative. This office ranked as one of the most important positions in the Venetian diplomatic corps (Ağır, 2015, p. 1; Dursteler, 2002, pp. 2-4).

Separate facilities for the quarantine of nobility, officers, and high-ranking dignitaries—a sort of "isolation within isolation" system—provided more space and comfort for patients, reducing the risk of cross-contamination with the other sick, typically referred to as *poveri* (the poor). The exclusive use of the Generalato to accommodate prominent figures is attested in a report of 1754, that highlighted the necessity for restoration interventions prior to the return of the *Bailo* of Constantinople (Venice, State Archives, *Procuratori di San Marco de Citra*, b. 361, fasc. C (5), the 3rd of September, 1754, cc. 5r-6v, letter of the Prior Giovanni Foscarini; 10th of October, 1757; Stevens Crawshaw, 2012, p. 93).

Neighbouring the Generalato was a structure denominated "Parlatory" in the map of 1818, also known as parlour. In a monastic context, a parlour was the designated area where monks and nuns could have conversations and interactions with people living outside the monastery. Vanzan Manocchi's map identifies it with the name *luoco delle visite* (place of visits), displaying the disposition of internal walls organising the layout. Much like monastic antechambers, this building was likely designed to permit external visitors to see their relatives confined within the lazaretto.

The walls built to segregate the entrance from the Prato della Tezzeta delimited the space, ensuring the safety of visitors and allowing quarantined patients to briefly reunite—with some distance—with their families. Considering the proximity of the parlour structure to the Generalato, it can be assumed that this sector was mostly used by the diplomats and nobles, who had the privilege to not be completely secluded during their treatment.

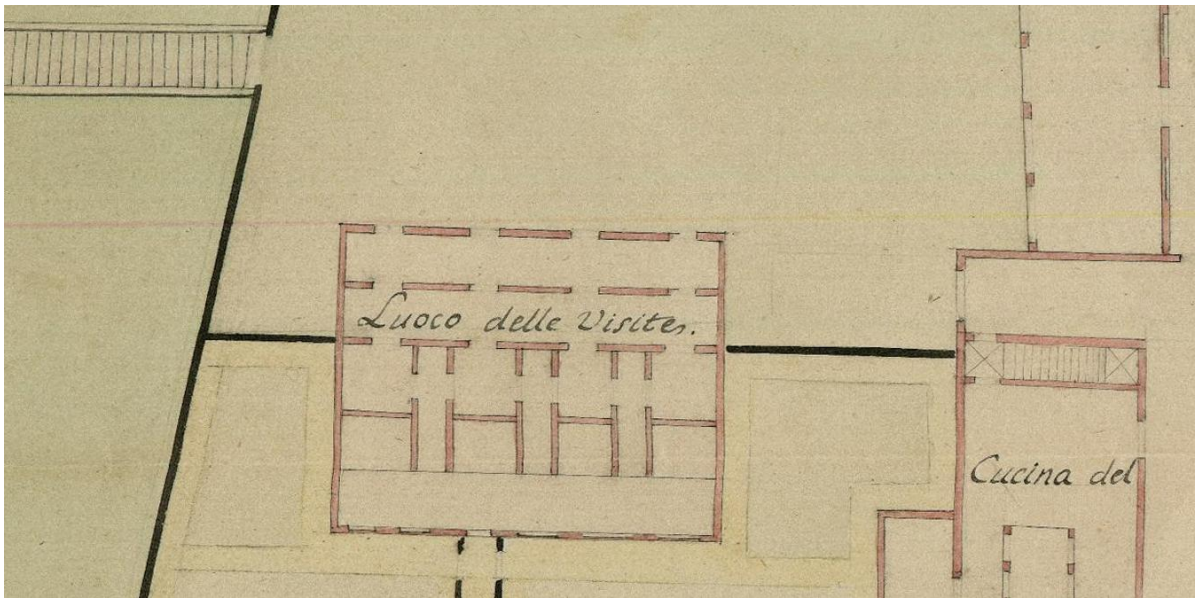

Figure 20. Detail of the Place of visits. Vanzan Manocchi, Map of the Lazzaretto Vecchio, 1813 (Venice, State Archives, *I.R. Magistrato di sanità marittima,* b. 60, drawing no. 1).

In 1787, Tommaso Scalfurotto coordinated a refurbishment in the Generalato. Records indicate that the works were carried out on the roofing and interior spaces, including the demolition of the fireplace previously located in the kitchen, and the creation of a new room on the upper floor (Venice, State Archives, *Provveditori alla Sanità*, b. 395, the 27th of December, 1787).

It is hypothesised that the system of columns and capitals in the *loggia*—unique within the architectural complex and described in detail in the following paragraph—was also the result of a restoration planned by Scalfuroto, resembling the proposed structure for the *contumacia* of passengers (Fig. 21), designed by the engineer around 1774 (Passante, 2020, p. 106).

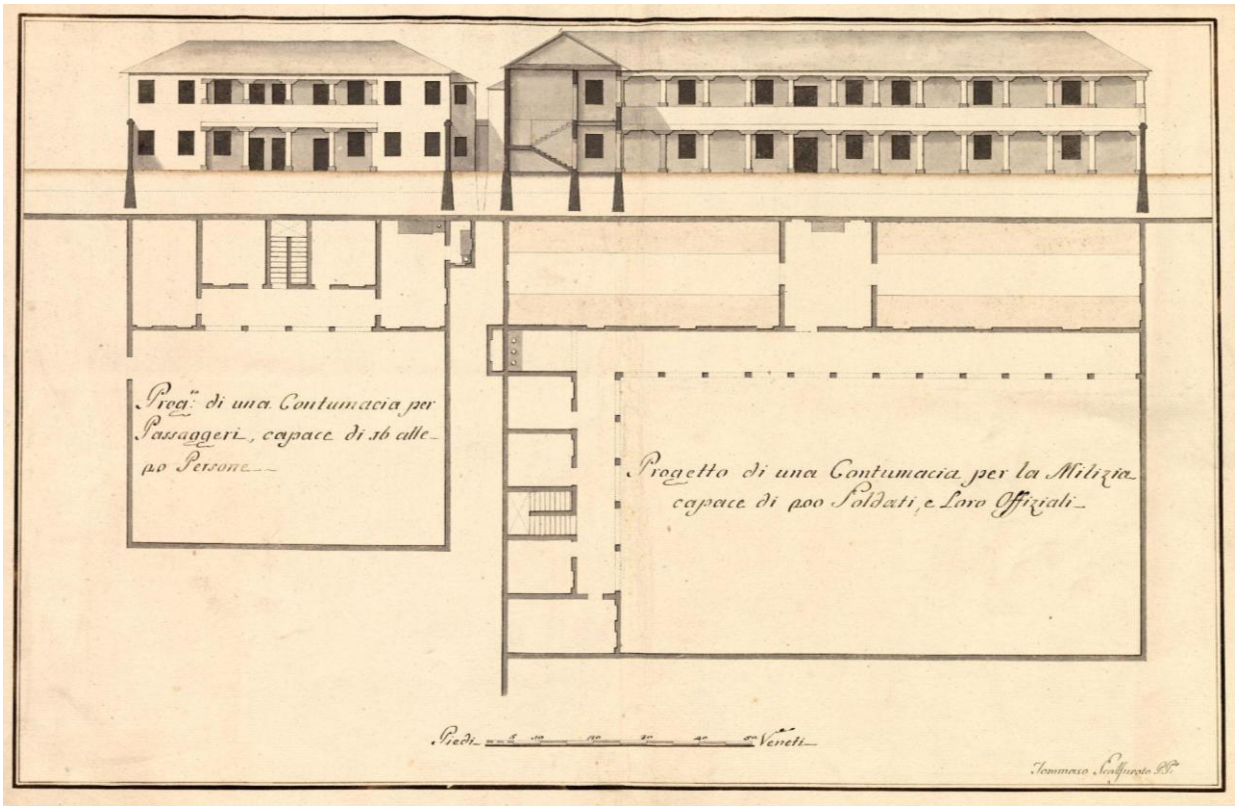

Figure 21. Tommaso Scalfuroto, Design for two places of *contumacia*, 1774 ca. (Venice, State Archives, *Provveditori alla sanità*, b. 11, drawing n. 20).

The most significant transformation of the building—during which more than half of its structure, including the northern part of the ancient cloister and the area identified as *Luoghi al Fondaco di Levante* in Vanzan Manocchi's map—was demolished, likely occurred between 1840 and 1860. Two iconographic sources help determine the period of this demolition: while the building is still visible in the Austrian cadastral made in 1838 (Fig. 16), it is no longer represented in the 1860s' map preserved in the archives of the Military District of Padova (Fig. 17), which already depicts the Generalato with the L-shape it retains.

Readaptations to the layout of the Generalato—including the demolitions and constructions of internal walls—occurred with little planning or documentation during its use as a military garrison (1852-1967), and later as a shelter for stray dogs (1978-1998).

3.2. ARCHITECTURAL ANALYSIS OF THE GENERALATO BUILDING

After discussing the historical sources related to the Generalato and outlining the sequence of events that shaped its architecture, this paragraph will focus on its geometry and construction. It will describe the spatial organisation and dimensions based on the floor plans, while also examining stylistic characteristics, building materials, and state of preservation of the façades.

The workflow started from the elaboration of geometrical shapes, through vectors, to represent the building's floor plans and façades. An architectural survey conducted in 2020 by the studio Ianus, commissioned by the Fondazione La Biennale di Venezia, utilised the laser scanning technique for the acquisition of *in situ* measurements, and was documented in DWG format file on AutoCAD 2D. The digital drawings were later refined by the author for a cleaner digital visualisation, with layers used for proper categorisation.

The surviving part of the previous Giamboniti monastery covers an area of 332 square metres on the ground floor, and 342 square metres on the first floor. Three doors on the southern façade provide access to the building, from the Corte del Priorato, while a fourth door is located on the eastern façade beneath the portico. On the ground floor of the east-west wing seven rooms are still distinguishable, and a large rectangular room in the north-south wing is identified as the original kitchen of the lazaretto and, perhaps, of the friary. Of the first floor, 84 square metres consist of the porticoed area, which is supported by nine columns on the ground floor and seven on the first floor. The colonnade system will be further described during the analysis of each façade.

The cistern, which once stood at the centre of the cloister, represents the solution elaborated by Venetians to obtain and store fresh water. Cisterns were developed in Venice with a meticulous filtration system using layers of sand, impermeable clay, and stone labs. The structure, made of stone, is likely one of the oldest constructions in the complex, possibly dating back to the settlement of the friars. It measures 120 centimetres on each side, and is 1 metre tall.

A staircase located at the northern part of the building—depicted in the same position on the 19th-century plan— leads to the upper floor, the only surviving level after the partial demolition of the structure, which previously accommodated three other stairwells. The individual chambers, initially used by the friars and later by the patients, can be distinguished, although the area distribution is not uniform, and the current configuration presents rooms of varying sizes.

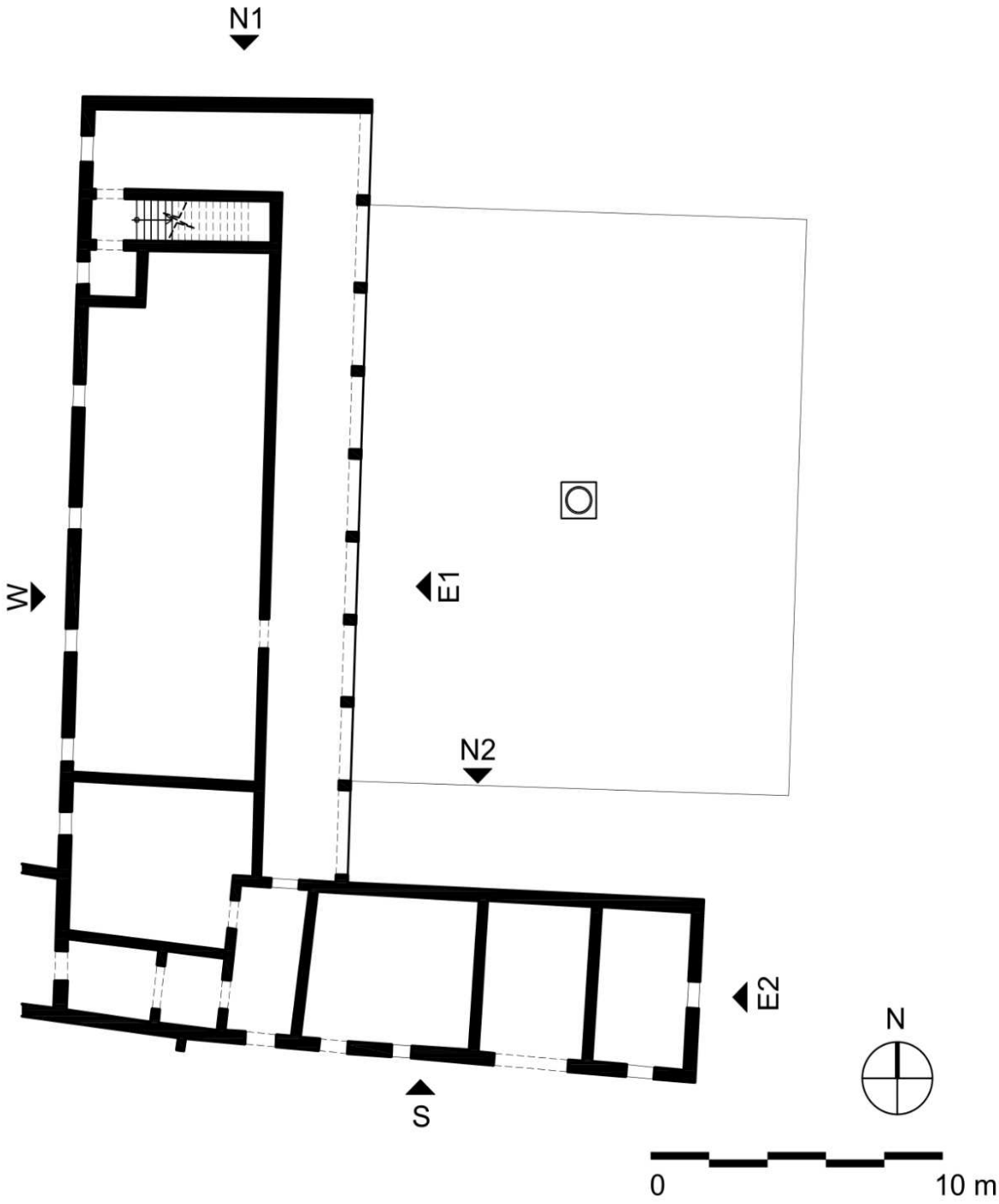

Figure 22. Ground floor plan of the Generalato's remains *in situ.*

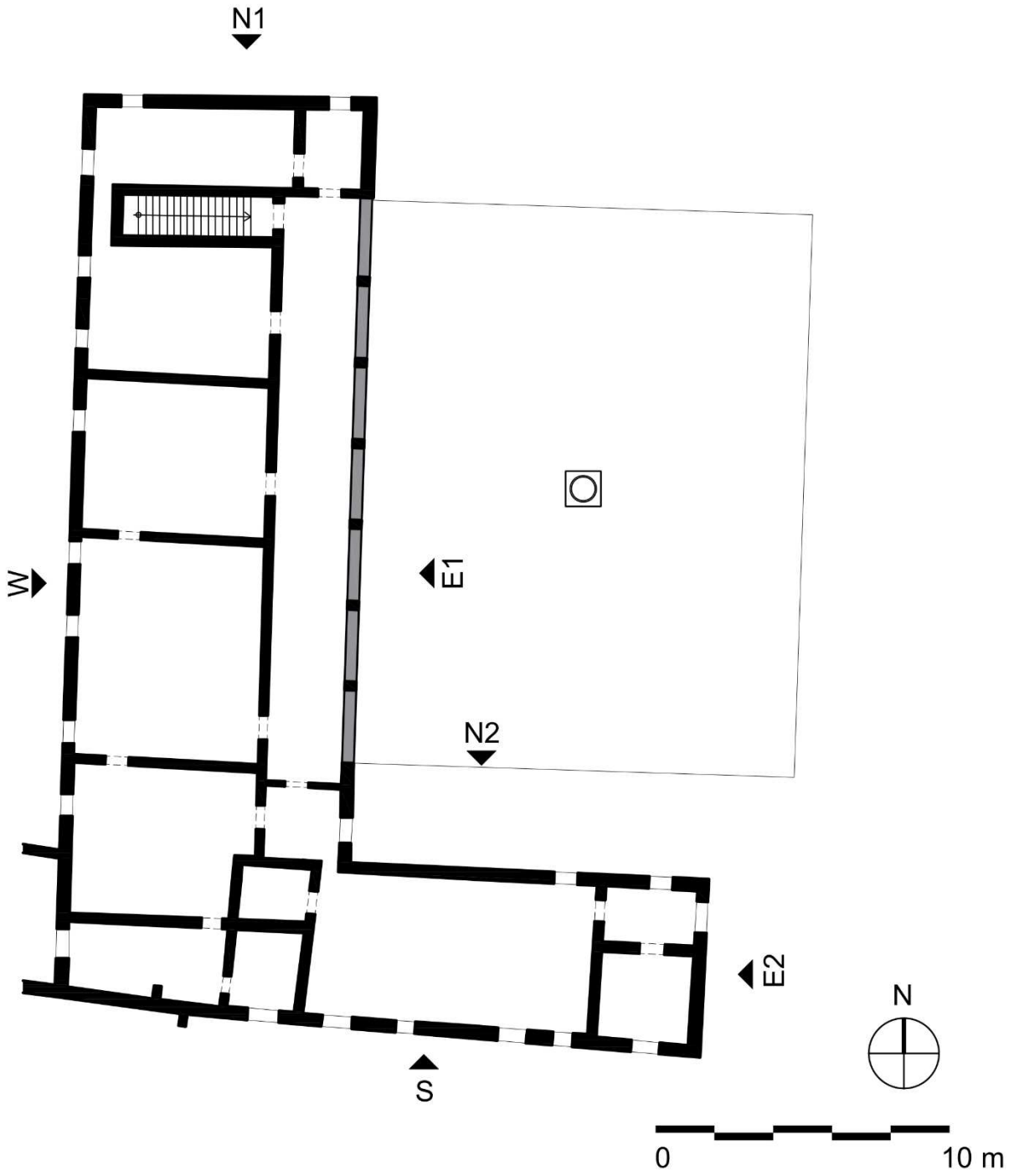

Figure 23. First floor plan of the Generalato's remains *in situ*.

Overall, the masonry walls of the building reveal bricks of varying shapes, sizes, colours, and states of conservation, reflecting the different restoration interventions carried out over time. Elements of Istrian stone are present, used as frames around doors and windows—ornamental features commonly found in Venetian architecture. This limestone, quarried in the Istrian Peninsula, is one of

the most important construction materials used in Venice due to its compactness, high compressive strength, and extremely low water absorption—qualities that make it highly resistant and durable in the lagoon's humid and saline environment (Foraboschi, 2017, p. 179).

The western façade of the Generalato, likely the one among the remaining that is closest to its original dimensions, measures approximately 30 metres. On the ground floor, a span on the left end forms a *sottoportego,* providing access to the previously existing courtyard. A series of six windows are present, with the possibility that the first and last openings in the sequence—which reach a height of approximately 30 centimetres above the other four—are the result of construction actions realised in different periods. The first window opening, measuring approximately 120 centimetres in length and 86 centimetres in height, was partially enclosed with bricks separated by approximately 10 centimetres in mismatched rows, as a see-through wall-filling element. The remaining five are enclosed by iron bars, and the sixth differs in geometry from the others, being square-shaped (each side measuring 100 centimetres) rather than rectangular (circa 100 centimetres in width and 130 centimetres in height). It is important to note that the right end of the ground floor of the Generalato was connected to the Prior's house, and the span of the door that once provided access between the two buildings is still visible, as well as the protruding wall connecting both structures.

A few noticeable features draw attention during the analysis of this façade. Prominent architectural elements present are the chimney breasts, structures that extend outward from the wall, made to accommodate the fireplace inside. On the first floor of the western façade, three such structures are present, each built using a different typology, which may indicate construction interventions from different periods. Despite their visual differences, the chimneys are consistent with the design of the monastery and were likely built with a more practical, utilitarian approach, prioritising function rather than aesthetics, without elaborate moldings and the decorative elements which are commonly found in Venetian architecture. At the bottom corners of these structures, attached to the extremities of a low-rise masonry arch, are corbels made of Istrian stone.

The different appearance of the bricks is not the only indicator of the sequence of events acted upon this façade. At least two window openings on the first floor were filled with brickwork, and traces of the removal of a previously existing chimney breast can also be recognised. These alterations display dynamics of anteriority and posteriority, and can be used as tools for a better understanding of the history of the building.

Figure 24. West (W) exterior façade of the Generalato.

The remaining southern façade spans approximately 22 metres and stands out as the most thoroughly recovered, following the efforts of the restoration carried out by the Superintendency in 1994. The entire lower section of the masonry was replaced and rebuilt, incorporating bituminous membranes for waterproofing. However, the overall use of construction materials unsuitable for the restoration of a historic structure reveals a lack of adequate planning prior to this intervention. Several Istrian stone capitals and corbels were also replaced, along with some trusses and sections of the roof covering (Passante, 2020, p. 64).

From left to right, the first access point to the building from the Corte del Priorato is marked by an arched entrance. On the ground floor, two windows of similar size are present (each approximately 93 centimetres in width and 175 centimetres in height), as well as three doors, each of them with a smaller opening above it and it is framed by masonry arches constructed with longitudinally laid bricks.

The upper floor is the part of the building with the largest quantity of external wall painting left. The chimney on this façade is unique within the Generalato: it has the shape of a slender, straight rectangular prism. This different typology may be an indication that it could have been built in a different period than the others, simplified and smaller in size due to different necessities.

This façade not only bears the marks of the 1994 restoration but also displays evidence of an earlier intervention, in the 18th century. This is attested by an epigraph in Istrian stone (Fig. 26), bearing the inscription: *"D(eo) O(ptimo) M(aximo). Hoc laemocomium restauratum fuit an(no) Dom(ini) MDCCLIV, sub Prioratu Ioanis Fuscareni"* ("To God, the Best and Most High. This

lemocomium was restored in the year of our Lord 1754, under the Priory of Giovanni Foscarini") (Passante, 2020, pp. 64, 95).

Figure 25. South (S) exterior façade of the Generalato.

Figure 26. Epigraph in Istrian stone, 1754.

Figure 27. Photograph of the southern façade of the Generalato before restoration, 1994 (Photo Archive *Soprintendenza archeologia, belle arti e paesaggio*, no. 72028-29).

Figure 28. View of the southern façade of the Generalato, after the restoration of 1994.

Indicated on the floor plan as N1, the northern façade measures 10 metres and constitutes the surviving part of the former cloister closest to the now-demolished church. Different periods of construction and restoration interventions can be assumed by observing the visual discrepancies in the masonry. One fourth of the façade, to the left, displays bricks in a paler color in comparison to the remaining third to the right. The top left part might be the oldest constituent of the façade; whereas a thin portion on the top of the centre-right part of the wall is visually similar to the masonry courses renovated in the restoration of 1994, and most likely was redone as well during the recovery of the roof structure. This hypothesis would need investigations through different analytical methods in order to confirm the precise dating of the bricks and mortars.

The wall which connects the Generalato to the Tezetta is visible on the ground floor. On the first floor, two window spans remain open, with only the wooden frames left. A chimney structure similar to one of those in the west (W) façade is present.

Figure 29. North (N1) exterior façade of the Generalato.

The porticoed façade facing east, indicated on the floor plan as E1, extends approximately 24 metres. The most striking feature of this façade—its colonnades—is inspired by the principles of formal classical architecture, in a rather minimalist interpretation, without elaborate carvings on the semi-elliptical capitals made of Istrian stone, and a plain entablature on the upper floor. Its simplicity and lack of ornaments recalls the language of the vernacular architecture in Italy, as well as the proportions that give the *loggia* a stout and sturdy-looking structure. Plaster residues on the left and

right ends of the first floor may indicate the presence of previously existing openings in the wall that were later sealed.

Figure 30. East (E1) exterior façade of the Generalato.

Figure 31. Photograph of the capital of the *loggia.*

Figure 32. Capital of the corner column of the former courtyard.

The façade facing the former courtyard, located on the east-west aligned wing of the L-shaped building, is indicated on the floor plan as N2. It spans approximately 15 metres. This façade also features various sections of brickwork made in different times, evidencing multiple phases of intervention. The bottom left corner may be the result of the most recent amendment. Adjacent to the roof, from the left corner up to the chimney breast, bricks similar to those used in the 1994 restoration are further evidence of the repairs carried out on the building's covering.

The chimney structure on this façade shows slight differences in design and proportion compared to others in the building. The stone slab used as a chimney cap on the structure in N1 may indicate an earlier construction, possibly reflecting a design choice primarily aimed at preventing rain from entering. In contrast, the clay tiles roofs over chimneys, such as the one in N2, were developed to facilitate more efficient smoke extraction through a louvered covering. However, it is important to note that none of the chimney structures present in the Generalato follow one of the most common typologies found in Venice—the so-called "a campana" type, named for its bell-shaped hood. In most historical iconographic depictions of the Generalato, the chimneys are shown with conical hoods, suggesting that all of the chimneys currently standing were, at some point, altered from their original form. The reason for this change is not confirmed, but may be related to functional or maintenance issues.

Figure 33. Second north (N2) exterior façade of the Generalato.

The façade identified as E2 is the smallest one, measuring approximately 6 metres, and is located on the east-west aligned wing of the L-shaped building. It shows a complex stratigraphy, with different groups of bricks representing various phases in the building's history. On the ground floor, to the left, the courses restored during the 1994 intervention contrast sharply with the remaining deteriorated masonry. At the centre of the ground floor, a window is enclosed by iron bars, similarly to those on the western façade. On the upper floor, only one opening remains.

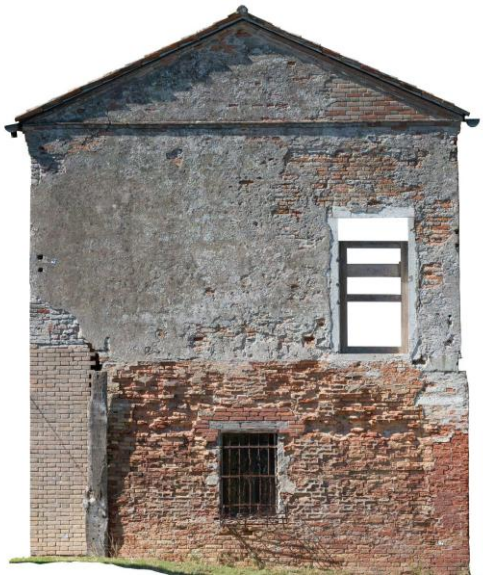

Figure 34. Second east (E2) exterior façade of the Generalato.

The interior of the building exhibits varying states of conservation and damage mechanisms. A large portion of the plaster—some of it contains ancient inscriptions (Fig. 35)—has detached, leaving the masonry walls exposed. Significant fractures and partly collapsed walls are present inside the structure. The first-floor attic of the building is not usable due to structural collapses (Passante, 2020, p. 64).

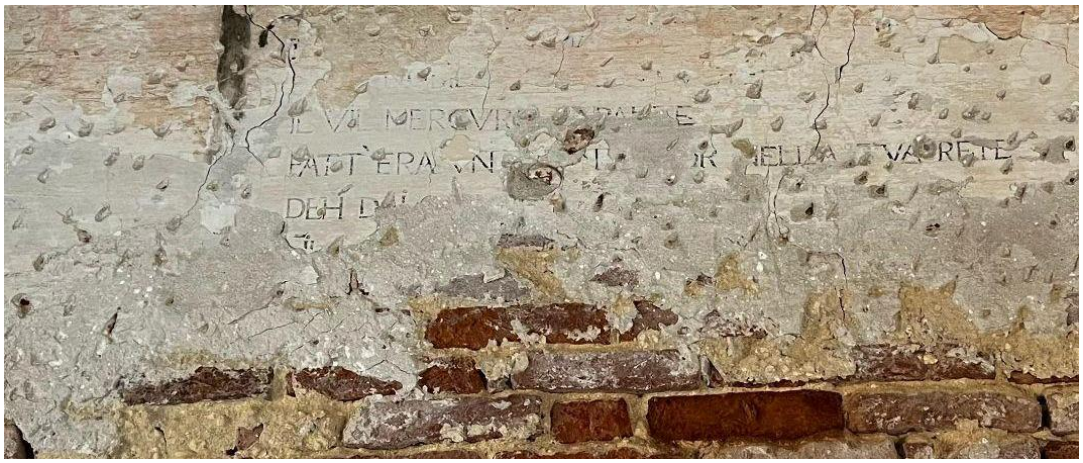

Figure 35. Photograph of ancient inscriptions remaining on an interior wall in the upper floor of the Generalato.

A fresco displayed on the wall of the remaining staircase connecting the ground and first floor is in a deteriorating state (Fig. 36), suffering from paint loss, flaking plaster, and other deterioration patterns. The painting depicts the Madonna and Child, accompanied by Saints Rocco and Sebastian, who were venerated in Venice as protectors against the plague. These figures also appear on the bas-relief made of Istrian stone that once adorned the Crozzola (Fig. 12). The soft tones and shading used in the mural painting, which create a sense of realism and volume in the facial expressions and drapery, suggest that it was likely executed between the 16th and 17th centuries, probably by a patient who had been treated in the Generalato, after their hospital discharge.

Figure 36. Frescoed wall on the staircase wall of the Generalato.

3.3. DAMAGE MAP AND VISUAL INSPECTIONS OF THE GENERALATO

As observed in the façades of the Generalato, the natural process of weathering of building materials, continuously exposed to atmospheric agents, can be aggravated and accelerated by lack of use and maintenance. The interaction between environmental factors and the materials—each with its own chemical and mineralogical composition—results in various forms of deterioration, with the specific characteristics of the materials playing a key role in the outcome of the decay.

The diagnosis of structure degradation mechanisms is a pivotal point in the analysis of architectural heritage, essential to propose the most effective treatments for the damaged materials, and promote the recovery and preservation of the building (Rocha *et al.,* 2018, p. 52). In order to investigate the anomalies present in the exterior of the Generalato and interpret their possible causes, a damage map was used as a tool, schematically registering the position of the different types of deterioration in the façade blueprints, identified during visual inspections. For a clear visualisation,

the weathering forms were categorised by different colours, creating a representative pattern, which was reproduced in all the façades.

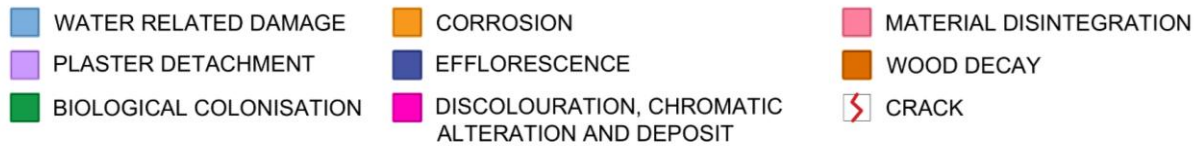

Figure 37. Colour legend elaborated for the damage map.

3.3.1. DESCRIPTION OF CATEGORIES ANALYSED IN THE DAMAGE MAPS

"Water related damage" was the name given to a wide category of issues caused by the presence of water in buildings. This group can be attributed to different origins: infiltration from roof, pipe leakage, condensation, rising damp, rainfall, etc (Proietti *et al.,* 2021, p. 1). Moisture distribution is a well-known, common phenomenon that afflicts historical buildings in the aggressive environment of the Venetian lagoon, and is strongly influenced by the material properties, such as porosity and capillary structure (Falchi *et al.,* 2018, pp. 117, and 121). It is evidenced by the presence of dark stains, indicators of moist areas, and by mold growth on the walls.

Figure 38. Mold growth caused by water infiltration on the N2 façade of the Generalato.

Plaster detachment is a common degradation mechanism observed in mortar deterioration. The detachment can happen due to several factors, increasing dampness or moisture in the walls being the primary agents. The presence of water induces expansion and contraction of plaster during temperature fluctuations, facilitating the formation of blisters, which can eventually burst. Structural stresses, such as cracks, might lead to crumbling of the plaster. Taking into account the history of the site, the heavy vibrations generated by the partial demolition of the Generalato building can also be considered a cause for this phenomenon. The loss of plasterwork in external walls not only renders a visual anomaly, but also facilitates the penetration of external agents in the masonry, consequently causing a reduction of structural durability.

Figure 39. Plaster detachment on the E1 façade of the Generalato.

Amongst the types of decay present in the masonry units of the building, biological colonisation can also be identified. The susceptibility of bricks to undergo biodeterioration are intrinsically connected to the material's properties, mineralogical composition and porosity surface roughness. The occupation of the surface or cavities within the porous structure of the bricks by plants and microorganisms such as bacteria, moss, algae, fungi and lichen might happen due to moisture, availability of nutrients, and environmental conditions, resulting in a combination that supports microbial life. Biological decay has been reported as a common occurrence on architectural ceramic materials, and its perpetuation is facilitated in abandoned structures that lack maintenance and accumulate organic debris under increased moisture levels (Coutinho *et al.,* 2015, p. 760).

Figure 40. Biological colonisation on the E1 and N1 façades of the Generalato.

Corrosion, the gradual deterioration of a metal by an electrochemical reaction with the environment, was also identified in drain pipes, nails, bars, and ties made of iron present in the Generalato. It can be further classified into different types, such as: uniform corrosion, when oxidation and reduction reactions are equally distributed over the metal surface; pitting corrosion, in which the depth of the damage is greater than its apparent diameter on the metal surface; crevice corrosion, between similar or different metals, or between a metal and non-metal surface; and galvanic corrosion, when two different electrically conductive metals are bonded together in a corrosive environment (Nieuwmeijer, 2005, pp. 546-547). Rusting, a type of deterioration that happens when iron reacts with oxygen and water, worsens over time with prolonged exposure to rain and salinity. The loss of material not only renders the elements unusable, but also causes the iron oxide to stain the masonry wall beneath them with its reddish color. The iron oxide stains, depicted in the map, are part of the category “Discolouration, chromatic alteration and deposit”, which will be further discussed later.

Figure 41. N1 façade of the Generalato, where a rusted downpipe is located.

Efflorescence is described by the ICOMOS International Scientific Committee for Stone (ISCS) as whitish, powdery, or whisker-like crystals on the surface of the material, typically composed of calcium hydroxide or of soluble salt crystals such as sodium chloride, resulting from the evaporation of saline water within the porous structure of the masonry units and further reaction with the atmospheric carbon dioxide. Moisture evaporation within the pores (subflorescence) can lead to crumbling, caused by the pressure exerted during the crystallisation process, which breaks down the brick (Brocken *et al.*, 2004, p. 315; ICOMOS International Scientific Committee for Stone (ISCS), 2008, p. 48).

The two different terms specify where the crystallisation occurs, however, while efflorescence is considered an aesthetic concern only, its presence is indicative of subflorescence, a phenomenon that directly affects the endurance and resistance of the masonry.

Figure 42. Efflorescence in an internal wall of the Generalato.

The category named as “Discolouration, chromatic alteration and deposit” consists of a broad range of visual anomalies. Discolouration and chromatic alteration might be considered equivalent terms according to the ICOMOS (ISCS), consisting of an alteration of the stone colour in one to three of the colour parameters: hue (prominent characteristic of a colour), value (brightness) and chroma (saturation); whereas deposit originates from the accumulation of exogenic material. Amongst the subtypes of discolouration/chromatic alteration are colouration, that is, change in hue, value, or gain in chroma; bleaching—or fading—due to chemical weathering of minerals (for example, reduction in iron and manganese compounds) or extraction of colouring matter (by leaching or washing out); and staining in typical yellow, orange, brown and black colors, usually given by the presence of carotenoids and melanins produced by fungi and cyanobacteria (ICOMOS International Scientific Committee for Stone (ISCS), 2008, pp. 44-46).

The ICOMOS glossary also includes dark moist areas in this category, however, for a more cohesive comprehension of the map, this type of pattern was mapped in the façades in the “Water related damage” group.

Figure 43. Chromatic alteration on the W façade of the Generalato.

"Material disintegration" was the name designated to the wide scope of investigation of the areas of material loss in the building's façades, particularly of the bricks, after already having lost their protective plaster layer, and the eroded stones.

Crumbling is identified by the detachment of small-scale aggregates, generally less than 2 cm in diameter, resulting from the loss of cohesion within the material matrix. Granular disintegration involves the progressive breakdown of the material fabric into particles corresponding to the size of its constituent mineral grains. Spalling covers the loss of material on a larger scale: chipping, flaking, and peeling are some of the detachment patterns included in this category. The formation of cavities and smoothing of surfaces, as well as delamination and exfoliation, were also included in this section of the diagnosis (ICOMOS International Scientific Committee for Stone (ISCS), 2008, pp. 18-30).

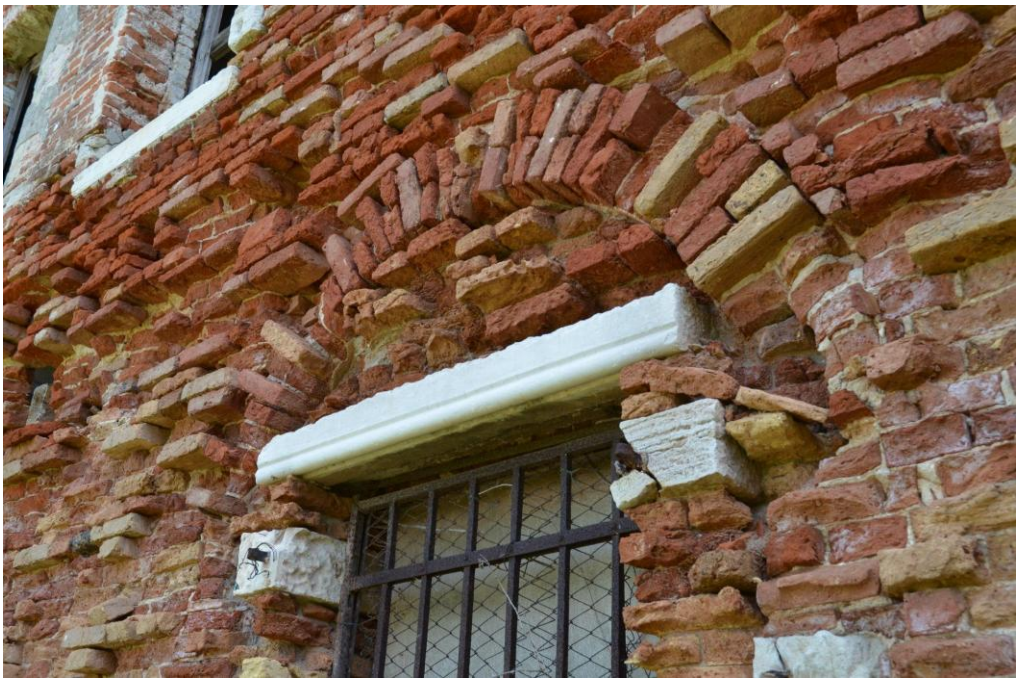

Figure 44. W façade of the Generalato, displaying detachment patterns analysed and identified by the "Material disintegration" category.

The category "Wood decay" was employed to designate the degradation processes affecting the wooden elements present in the Generalato. Although the primary catalyst for wood deterioration is the presence of moisture, the specific physical and chemical properties of this material required a separate analytical framework.

As a porous and hygroscopic material, wood swells and shrinks in response to fluctuations in humidity, taking up water in liquid and gaseous form. Repeated cycles of wetting and drying, as well as freezing and thawing, can induce mechanical stress, resulting in the formation of cracks and progressive material disintegration. Furthermore, the organic composition of wood, under conditions of long exposure to moisture, renders it an ideal environment for fungal growth and colonisation. Fungi accelerate the natural decomposition process of the material by breaking down the wood's cellulose, hemicellulose, and lignin, thereby undermining its mechanical strength, and compromising its structural integrity (Brischke *et al.,* 2020, p. 3782).

The attack of wood by blue stain and mould, regarded mainly as an aesthetic problem since they do not degrate the core structural biopolymers, was also mapped in this category, identified by the superficial discolouration or dark-coloured stains in the material.

Figure 45. View of the E1 façade of the Generalato, displaying wooden beams in an advanced state of decay.

The glossary on stone deterioration patterns defines crack as an "individual fissure, clearly visible by the naked eye, resulting from separation of one part from another" (ICOMOS International Scientific Committee for Stone (ISCS), 2008, p. 10). It also includes the term fissure as a subtype, identifying a crack that crosses completely the stone or masonry piece, and other terms designating cracks in smaller sizes or different shapes. For the mapping of cracks present in the façades of the Generalato, vectors—in the form of polylines—were drawn in the red colour, reproducing the position and extension of these defects.

Figure 46. View of the E2 façade of the Generalato, where cracks can be noticed.

3.3.2. DAMAGE MAPS: PATHOLOGICAL MANIFESTATIONS AND THEIR POSSIBLE ORIGINS

The west façade of the building displays extensive weathering, with several areas of surface erosion and loss of bricks, the latter being more concentrated in the ground floor near the base and the corners. Following the detachment of the external protective rendering, the bricks become more prone to decay, facilitated by environmental stressors and lack of preservation. The pipes on the façade, as well as the iron bars enclosing five windows on the ground floor, are rusted and corroded. The most recurring chromatic alteration on the bricks are the yellowish stains caused by microorganisms.

Efflorescence and moss growth are mostly registered on the lower part of the building, probably due to capillary action, indicating prolonged humidity on the ground. Dark damp stains are visible in the upper portions of the façade, particularly where remnants of plaster remain. These were likely exacerbated by water infiltration from the roof, resulting from the failure of the drainage system following its corrosion.

Soil-structure interaction can largely contribute to the damage mechanisms of the building. Land settlement due to the weight of the construction, natural or anthropic alterations of the soil conditions (the first being recurrent in Venetian territory, and the latter a consequence following the demolitions that happened in the site), change in loads related to construction transformation, among others, are factors that induce the formation of cracks, which can mostly be seen in areas where failures in the building's supports occur. This might explain part of the cracks present not only in the western façade but in the entire Generalato, caused by consolidation phenomena or changes in groundwater level, for example. The cracks take place where the building forms naturally-occurring resisting arches to transfer the loads down to the foundation.

Another hypothesis for the origin of cracks in this façade are the irregular and inconsistent interventions carried out in the building, which are evidenced by the marks of infilling and alteration of windows and doors to the left and in the centre of the façade, as well as the recognisable traces of the removal of a previously existing chimney breast in the upper floor.

Figure 47. Damage map of the west (W) façade of the Generalato.

After the restoration of 1994, the south façade displays the least amount overall of damaged areas. However, natural weathering processes are sped up with the abandonment of the site, and this is noticeable after three decades of neglect of the building. The restored brickwork of the lower part of the wall presents considerable occurrence of efflorescence, indicating the decay of the most recent bricks' core integrity. Traces of differential erosion are visible on some of the frames made of Istrian stone, that is, following an irregular rate of deterioration that results in relief formation. This mechanism of deterioration is in accordance with the nature of the stone, according to the ICOMOS (ISCS), which associates this feature with sedimentary, harder, less porous stones (ICOMOS International Scientific Committee for Stone (ISCS), 2008, p. 30).

The upper floor of the southern façade, despite being the part of the building with the largest quantity of external wall painting left, shows significant peeling and delamination, leaving both render and masonry exposed—the latter already severely damaged on the leftmost area. Staining and discoloration patterns on the wall can be traced back to water runoff, biological growth, and iron corrosion.

Diagonal cracks near the windows are most likely indicative of differential soil settlement, as previously mentioned. The stress, distributed unevenly across the structure, should be most concentrated around the voids in the masonry.

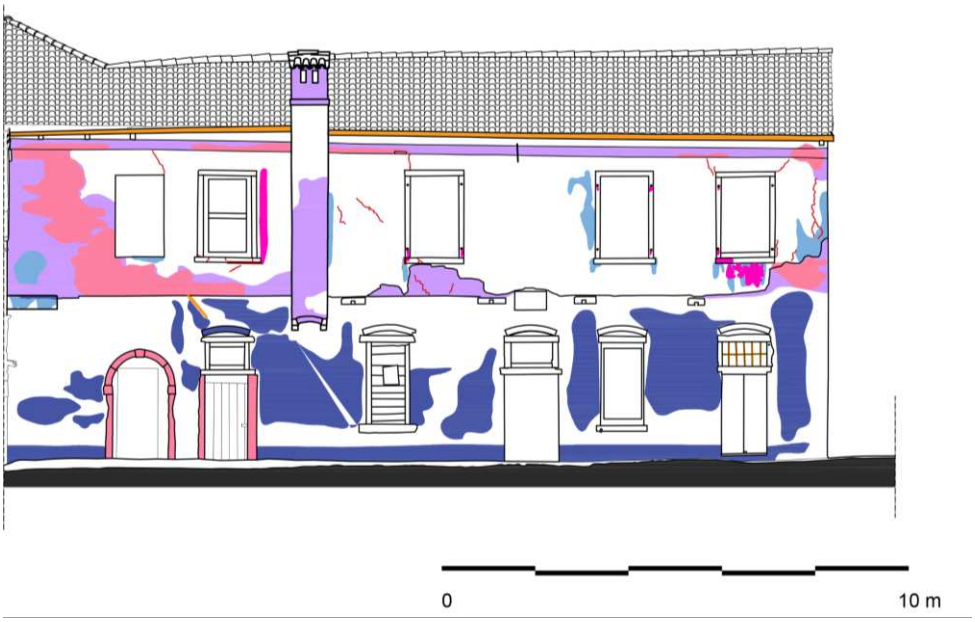

Figure 48. Damage map of the south (S) façade of the Generalato.

The different groups of bricks on the north façade, distincted during the architectural analysis by their disparate colours and state of conservation, are indicators of various moments of intervention—stimulating stresses on the structure, which could explain the visible cracks distributed on the wall. Lacking the external plaster almost entirely, the façade registers the same dilapidation patterns observed in the entire Generalato.

Figure 49. Damage map of the north (N1) façade of the Generalato.

In accordance with the main characteristic of the east façade, the structural deformation occurring particularly in the centre of the colonnade system on the ground floor appears to be the most concerning feature of this damage map. Deflection, a stress deformation that describes the sagging beam sustaining the upper gallery, curving transversally to its longitudinal axis, can indicate differential foundation settlement under the central columns—a condition that might as well be confirmed by the misalignment and tilting of the columns, and by the diagonal cracks on the upper floor, to the right. However, structural investigation carried out in the building confirmed that the largest crack in this part of the façade is a lesion originated from angular overturning, likely due to the fact that the existing wall was subsequently infilled following the demolition of the original cloister, without the provision of an adequate structural connection to the surrounding elements.

The rotting of the wooden elements—clearly visible in their deteriorated state—has led to the partial collapse of beams and floor structures. As a result, the loads originally supported by these elements might have been redistributed to the remaining structural members, whose actual load-bearing capacity may be inadequate for the increased stress they are now subjected to.

Figure 50. Damage map of the east (E1) façade of the Generalato.

The second façade facing north, named N2, similarly displays extensive signs of decay induced by prolonged neglect. Dark stains, concentrated mostly on the areas of remaining plaster, were identified as moisture infiltration. Compromised downspouts might have worsened the water

related damage, facilitating rainwater ingress into the masonry. Lack of sun exposure in this façade might have also contributed to moisture patches, efflorescence, and biological colonisation. Several exposed bricks on the lower floor appear eroded, and show different patterns of detachment.

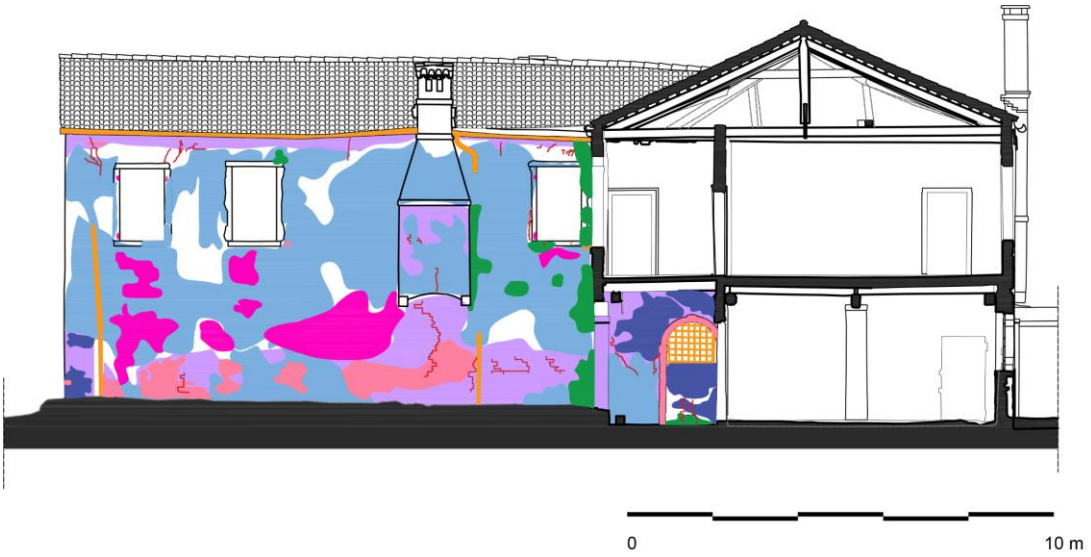

Figure 51. Damage map of the second north (N2) façade of the Generalato.

The façade identified as E2 shows similar deterioration characteristics from the previous ones. The disintegration of the bricks, mainly concentrated on the exterior of the ground floor, allows the visualisation of a second leaf of the masonry. Application of thick mortar was carried out in some of the joints and even inside voids left by missing masonry units, likely as a fast mending intervention. However, it is important to take into account that mortars tend to contract and shrink once they dry—this is normal to a degree, but the shrinkage might contribute to structural complications when the mortar is applied in larger gaps.

The exceeding of the stress component to its strength component in masonry buildings might be influenced and facilitated by the overall quality of the structural mortars binding the brickwork together. Medieval mortars, commonly characterised by brittleness and heterogeneity, generally present low adhesive quality and resistance to stresses, resulting in the formation of cracks (Chitte *et al.,* 2018, p. 456; Vitti, 2018, p. 164). Identification of mortar typologies present in the Generalato building would require further analytical investigations through sampling, but hypotheses about the production processes can be assumed considering the history of the site. The Lazzaretto Vecchio complex required fast expansion interventions and repairings, due to the increasing number of

patients in need to be admitted to the facility. The urgency factor might have led to a poor selection of raw materials, inappropriate burning of lime, and rushed slaking practices. The environmental exposure and lack of maintenance, as already stressed, would further the degradation.

Another hypothesis regarding degradation due to mortar incompatibility is that the urgent repairings carried out on the building were executed using Portland cement. The higher hardness and lower flexibility of Portland cement, compared to traditional lime mortars, may have led to excessive stress concentrations within the masonry, resulting in material loss. Furthermore, the reduced permeability of cement likely restricted moisture evaporation, leading to rising damp and salt crystallisation within the masonry. Additionally, external sulfate attack might have occured due to penetration of sulfate ions from seawater, triggering internal stresses caused by volume expansion, ultimately compromising the material's strength and cohesion.

Figure 52. Damage map of the second easy (E2) façade of the Generalato.

4. Digital reconstruction of the Generalato

4.1. THE METHODOLOGICAL APPROACH

This research project aims to create a virtual reconstruction of the Generalato as it appeared prior to the 19th-century demolition, through the integration of advanced technologies and a wide range of historical and archival sources. The objective of illustrating the building's appearance in its final stage before demolition serves as a tool for spatial analysis of the structure's life and architectural transformations, offering important insights into the history of the site.

3D modelling software—specifically AutoCAD 3D and SketchUp, in this case study—is employed for the virtual reconstruction, based on information acquired *in situ* from the remaining buildings of the Lazzaretto Vecchio. Historical Geographic Information Systems (HGIS) techniques are also used to georeference historical maps and determine the correct positioning and scale of the lost structures within the complex.

The main challenges encountered in developing a scientifically accurate reconstructive hypothesis are primarily related to the lack of detailed iconographic sources. To address this, logical reasoning and comparisons with the surviving architecture of the complex are combined to support the design and modelling decisions made during the reconstruction process.

4.1.1. 3D MODELLING OF ARCHITECTURAL HERITAGE

Digitalisation has recently begun to be recognised and applied as a powerful tool for the recovery and preservation of architectural heritage. The *as-built* digital documentation of historical buildings can be a pivotal resource for structural analysis and assessment, risk management, and plannings for conservation and restoration. Furthermore, the virtual reconstruction of lost or heavily modified sites—such as the Lazzaretto Vecchio complex—can provide a valuable complement to historical data, enabling the visualisation of physical transformations through a multidimensional approach.

Advancements in the field of Architecture, Engineering, and Construction (AEC) have facilitated the cataloguing and analysis of changes in culturally significant buildings and sites. The technological expansion began with the spread of Computer-Aided Design (CAD), initially developed in the mid 1940s and largely improved since the 1960s. It culminated in the emergence of

a more efficient and integrated methodology known as Building Information Modeling (BIM), which encompasses various representations of the physical, functional, and semantic characteristics of a building within a 3D digital model. Heritage BIM (HBIM) is a specialised brand of BIM that focuses on representing the geometry and information of historical buildings, taking into account their artistic, historic, and constructive typologies. This field has grown significantly and is now considered a revolutionary emerging technology in research areas concerned with ancient settlements (Argasiński *et al.*, 2023, p. 87; Diara, 2022, p. 1; López *et al.,* 2018, p. 14; Rebec *et al.*, 2022, p. 30).

The virtual reconstruction for the documentation of historical-cultural heritage is a task that requires balancing scientifically based assumptions with heterogeneous, complex, and irregular characteristics and morphologies that are not easily captured using modelling software (López *et al.,* 2018, p. 11). To address this issue and ensure that the resulting model aligns with the goals of the virtual heritage concept—which uses computer-based interactive technologies to record, preserve, or recreate objects and sites of cultural significance—the principles proposed by Pietroni *et al.* (2021, p. 6) are employed. According to these, digital reconstruction should not be limited to the reproduction of the object but should communicate its meaning, making it legible—that is, identifiable in its shape, content, and functionality—as well as recognisable and contextualised.

The Seville Charter defines virtual reconstruction as a digital method that employs a "virtual model to visually recover an archaeological site at a given moment in the past, including material culture (movable and immovable heritage), environment, landscape, customs, and general cultural significance" (Lopez-Menchero *et al.,* 2011, p. 2). Pietroni *et al.* (2021, P. 5) also emphasise the importance of extending critical hypotheses, underlying the need to document the varying levels of reliability clearly and distinctly.

The 3D modelling design process can be developed in two initial phases. The first, referred to as the knowledge phase, begins with historical research—investigating past events and their representation in the building's design. This is followed by metric surveys to acquire the data that will later be digitised, employing different techniques such as laser scanning, photogrammetry, and *in situ* inspections. The development of the model depicting a heavily transformed structure (as in this case of the Generalato prior to its demolition) requires analytical and philological interpretation of sources, leading to an hypothesis based on both textual and iconographic evidence.

The translation of the scope of this research into a virtual reconstruction was achieved through the combined use of different three-dimensional design software. AutoCAD, a computer-aided design software application developed by Autodesk, is widely employed for the creation of technical

drawings and 3D models in the AEC field. Its primary file format, DWG, can be exported to compatible platforms that are used in conjunction to enhance the modelling process. SketchUp, initially developed by At Last Software and owned by Trimble Inc since 2012, is another widely used 3D modelling software that offers a range of tools facilitating an interactive and intuitive design process.

4.1.2. HISTORICAL GEOGRAPHIC INFORMATION SYSTEMS (HGIS)

A geographic information system (GIS) consists of a database technology that stores, manages, edits, and visualises spatial data in the form of points, lines, polygons, or grid cells, via computer software or hardware. Similarly to HBIM, HGIS is a sub-field that has gained prominence in cultural heritage disciplines since the late 2000s, encompassing the analysis of historical territories as a dynamic working tool used to track territorial changes over time (Gregory *et al.,* 2007, p. 639).

A prominent method for the use of HGIS relies on the digitalisation and georeferencing of historical maps, cadastral records, photographs, and archaeological findings—that is, by selecting so-called "control points" on the scanned images to be aligned with actual geographic locations, meticulously selected based on identifiable corresponding points. These documents are unified in a single platform, aligning historical information with modern coordinates. Geographic principles of cartography, especially scale and projection, need to be understood and mastered in order to accurately provide spatial dimension to the past (Rumsey *et al.,* 2002, pp. 2-6).

To optimise the information provided by the historical drawings, the georeferencing step of this work was carried out using QGIS, a free, open-source Geographic Information System, commonly used in historical research and HGIS projects due to its layer-based system, which facilitates the visualisation of different types of spatial data: raster, vectors (points, lines, or polygons), and attributes—i.e., information attached to the vectors.

4.2. PROCESS AND RESULTS

The measures taken in 2020 of the building's remains were subsequently combined with the information displayed on the drawing by Vanzan Manocchi (Fig. 53), which represents the most complete depiction of the Lazzaretto Vecchio's ground floor plan prior to the demolition.

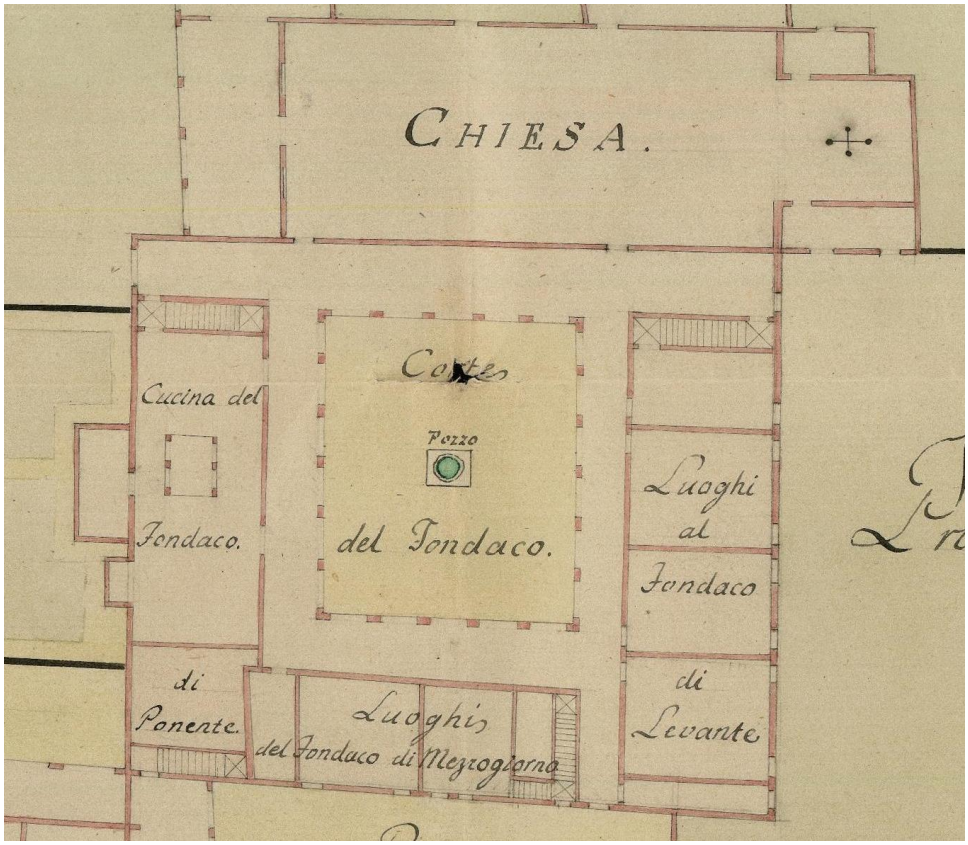

Figure 53. Detail of the Generalato. Vanzan Manocchi, Map of the Lazzaretto Vecchio, 1813 (Venice, State Archives, *I.R. Magistrato di sanità marittima,* b. 60, drawing no. 1).

Manocchi's plan was imported into AutoCAD and scaled according to the unity of measurement indicated by the engineer in the bottom left corner of the map: the units used were Venetian steps (*passi*) and feet (*piedi*), equivalent to 1.738 metres and 34.76 centimetres, respectively.

The plan by Manocchi did not perfectly align with the Generalato survey obtained through laser scanning. This discrepancy may be attributed to the fact that Manocchi's drawing was a copy, suggesting that the engineer did not necessarily resurvey the site but simply updated the 17th-century existing map with more recent interventions. Distortions and scale shifts are common challenges when digitising historical documents, and these must be considered during digital reconstruction. Furthermore, structural modifications—either human-induced or resulting from degradation—over the three centuries between the elaboration of Manocchi's map and the 2020 survey likely contributed to the observed differences in the internal layout.

This assumption was subsequently confirmed though the georeferencing process conducted using QGIS, version 3.36.1. Manocchi's map was georeferenced onto a base map developed by OpenStreetMap, accessed within the software, which displays the current configuration of the

Venetian lagoon and archipelago. The coordinate reference system used was EPSG: 3857 — WGS 84 (Pseudo-Mercator), applying the Polynomial 1 transformation type. The selection of corresponding points began with the island's boundaries and the Ortaglia, taking into account that the land extension had not been modified since the second construction phase, which occurred during the 17th century, almost two hundred years before the elaboration of Manocchi's map. Additional control points were added based on the location of the remaining buildings, including the Generalato, the Prior's house, the Contumacia alla Crozzola, and the *tezoni.*

Figure 54a-b. Georeferencing process carried out on Vanzan Manocchi's map through the QGIS software.

By adjusting the transparency of the georeferenced map, it was possible to observe the dimensional disparities between the selected historical drawing and the current geographic database. This step proves to be extremely effective and important in ensuring a proper interpretation of the architectural space, preceding the integration of the *in situ* measurements of the building's remains with the information provided by the historical iconography.

This digital reconstruction study benefited from an excellent contribution: the drawing (Fig. 55) produced by architect Giorgio Barletta, based on the research of scholar, professor, and president of the Archeoclub of Venice, Gerolamo Fazzini. A few valuable elements were adopted from this drawing. The first concerns the difference in level between the central courtyard and the covered passageways, and the presence of steps connecting them. A second feature incorporated from Barletta and Fazzini's work was the decision to leave the upper part of the northern *loggia* as an uncovered terrace. The absence of historical iconography depicting the Generalato's first floor prevents certainty about this space; however the design choice made by Barletta and Fazzini was accepted, as it is consistent with other examples of monastic cloisters with similar configurations, such as the former Tolentini monastery in Venice (Fig. 56).

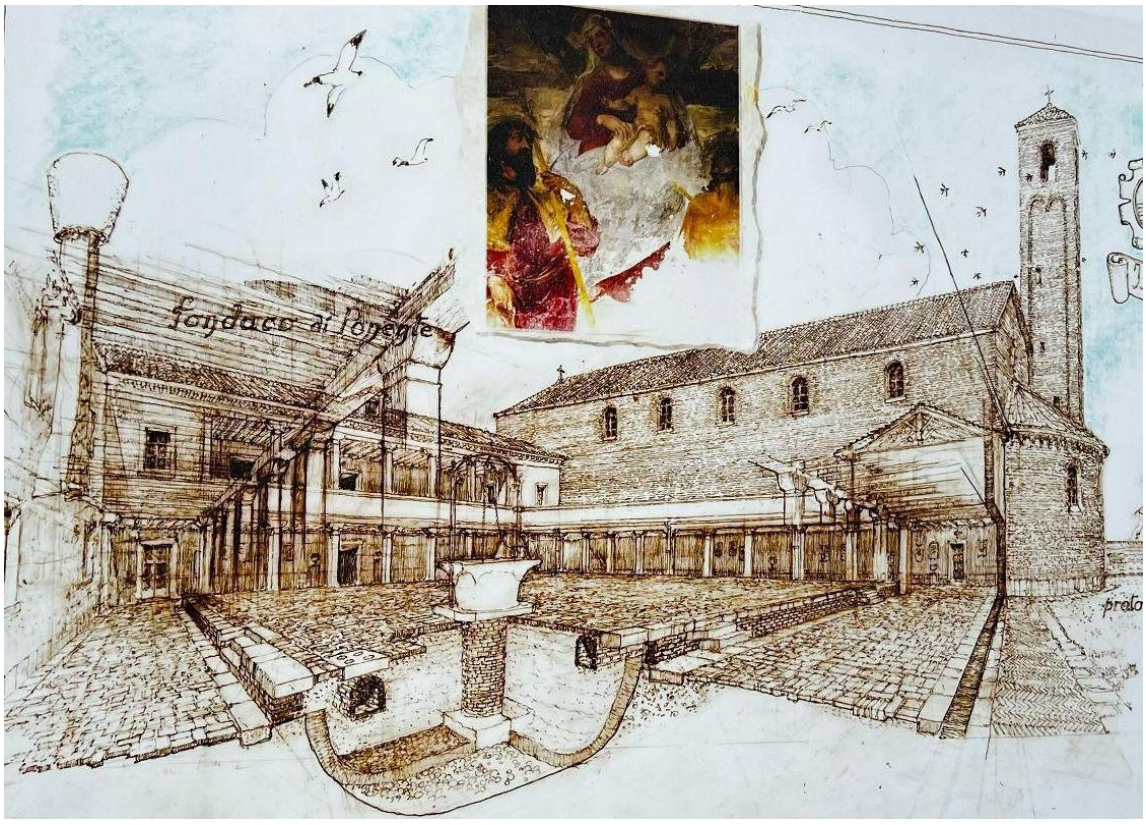

Figure 55. Drawing of reconstruction of the Giamboniti cloister and the Santa Maria di Nazareth church, by Giorgio Barletta and Gerolamo Fazzini.

Figure 56. Cloister of the former Tolentini monastery, Venice.

The ground floor plan (Fig. 57) digitalisation resulted in an estimated area of approximately 1,210 square metres. On the western side of the ground floor, Manocchi depicted a kitchen (*Cucina del fondaco di Ponente,* "kitchen of the western warehouse") with six internal columns, each measuring approximately 30 centimetres by 40 centimetres, which are no longer present in the current layout of the building. It is important to observe that the historical map does not display any of the windows that are currently present on the ground floor of the western façade. This lack of information leads to two hypotheses: the first, that all of the windows were added after 1813; and the second, that Manocchi chose not to represent them, for unknown reasons. It is not possible to know this for certain, but it is highly unlikely that a kitchen—logically prone to being filled with steam and cooking odours—would have been designed without any windows for ventilation, especially in the context of the Lazzaretto, where airflow was considered one of the key tools to combat the plague. For this reason, the choice was made to include the currently existing windows in the digitalisation and 3D model. Although this historical research cannot precisely date the present windows, their inclusion reflects an effort to be consistent with the available evidence.

Additional storage rooms are represented on the southern and eastern sections of the building, identified in the 19th-century plan as *Luoghi del Fondaco di Mezzogiorno* and *Luoghi al Fondaco di Levante,* respectively. On the southern façade, the door currently located closest to the Prior's house,

on the left, and giving access to the courtyard, was also not represented by Manocchi. However, an analysis of the weathered condition of the Istrian stone frames surrounding this door suggests it was not added after the 19th-century demolition. It may have been added sometime after 1697 and was therefore not present when Giovanni Antonio Cornello first drew the map, which could explain why Manocchi omitted it when reproducing the earlier plan. In the interest of producing the most accurate reconstruction possible, this missing door was included both in the plan and in the model.

To outline the perimeter of the former cloister's courtyard, the positioning and spacing of the remaining columns were mirrored on the opposite side, following the indications provided by Manocchi's map. For the northern and southern colonnades, the layout was based on the placements shown in the historical map, maintaining proportional spacing with the surviving columns. Steps were added in the plan, indicating that the central courtyard, where the cistern is located, sits at a slightly higher level.

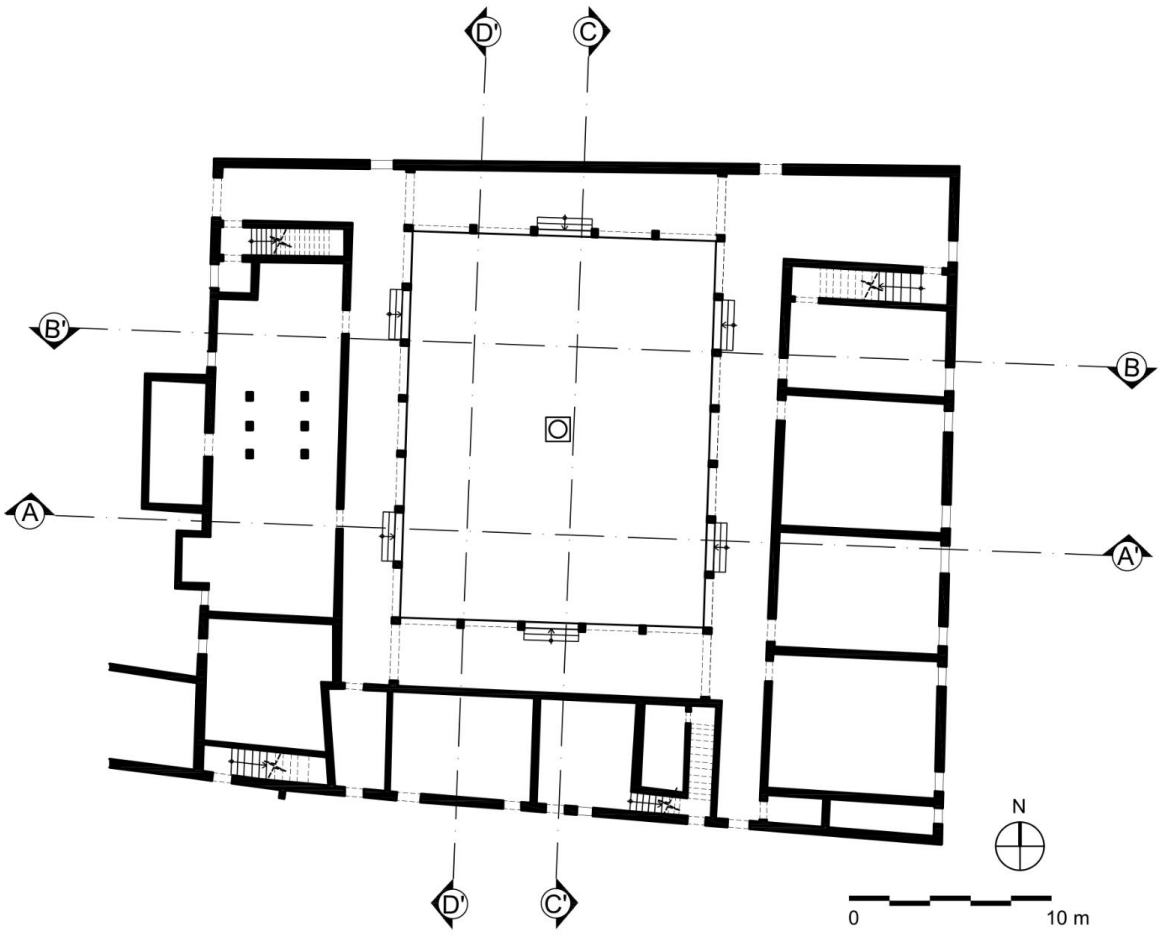

Figure 57. Ground floor plan of the Generalato in the early 19th century, adapted from Vanzan Manocchi's map.

Without any historical records of the Generalato's first floor, the digital plan resulted from an hypothesis based on what currently remains of the building and the theory that the upper layout likely followed that of the ground floor, with its rooms serving as bedrooms for the patients, and before that, cells for the monks. In 1662, a description by the notary Lorenzo Trevisan attested to five rooms on the western wing of the building, for the *Baili* and Rectors, and only three on the eastern one, called Belvedere, overlooking the space designated by Manocchi as "Primo Prato del Morone" (Venice, State Archives, *Procuratori di San Marco*, *de citra*, b. 362, fasc. A, June 25th, 1662; Galeazzo, forthcoming). The 17th-century document turned out to be valuable for the design of the demolished eastern wing, where three large bedrooms were added according to the report. However, regarding the western wing, the survey data was kept, prioritising the most concrete information about this sector.

On the northeastern corner, the existence of an antechamber was hypothesised, connecting the stairs to the porticoed halls, attached to the church's southern façade wall.

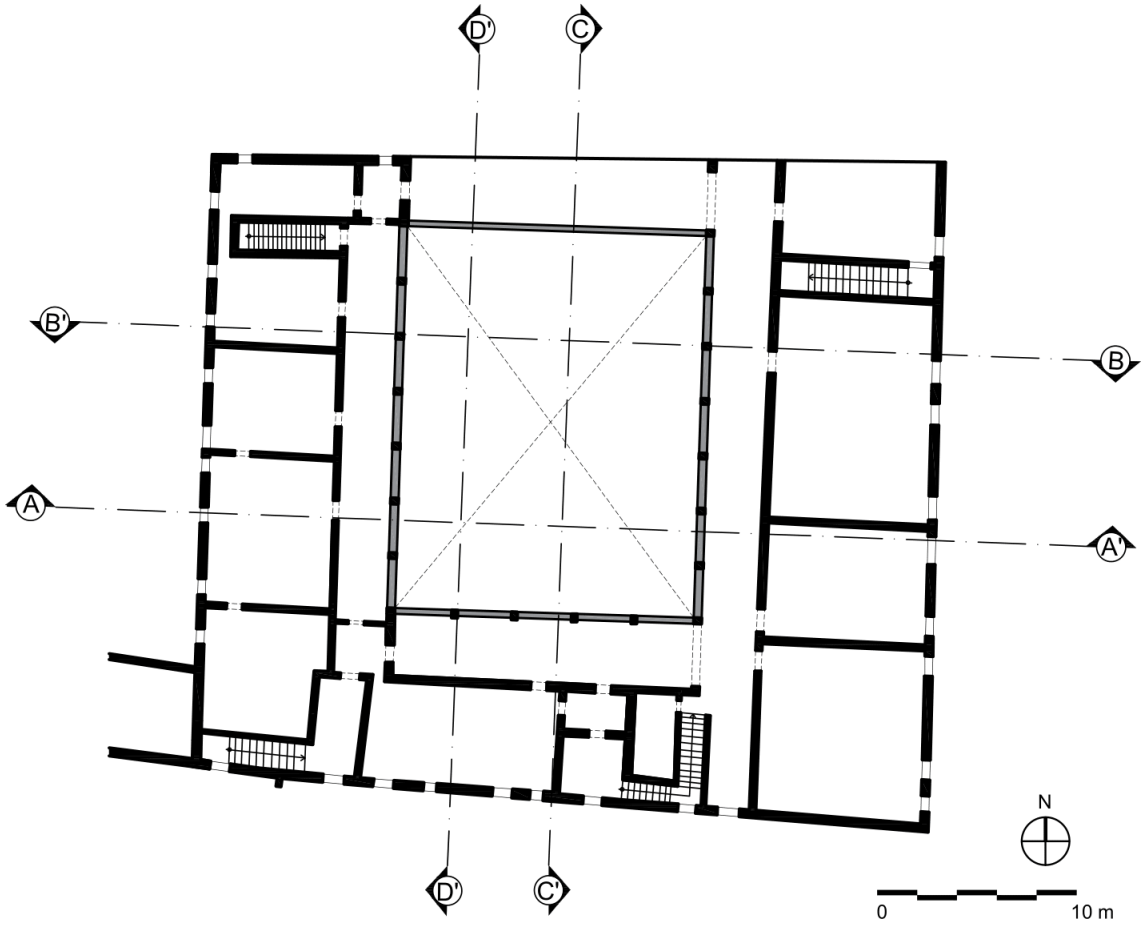

Figure 58. First floor plan of the Generalato in the early 19th century, hypothesised from *in situ* remains and historical descriptions.

An 18th-century engraving by Francesco Zucchi (Fig. 59) suggests that the windows of the Generalato were aligned in a similar arrangement for both floors. However, when compared to the building's current western façade, it can be assumed that either the artist decided to represent them in this way for aesthetic or compositional purposes, or that several modifications were made in the following centuries. Nonetheless, Zucchi's depiction inspired the façades representations in the 3D model.

Figure 59. Francesco Zucchi, View of the Lazzaretto Vecchio, 1740.

As previously mentioned, the *vedute* are of tremendous importance in aiding digital reconstruction work. Francesco Guardi's depiction of the Lazzaretto Vecchio (Fig. 60) is one of the historical representations that supported the decision to model the Generalato's chimneys following the traditional Venetian "a campana" typology. Visual inspections of the various examples of chimneys in the Generalato led to the conclusion that at least the upper parts were redone after the building's partial demolition.

Figure 60. Francesco Guardi, View of the Lazzaretto Vecchio, 1770 ca.

Figure 61. Traditional chimneys “a campana” in Venice.

The volumetric representation of the Generalato, prior to the partial demolition that occurred in the mid-19th century, started with the creation of basic geometric shapes from the 2D lines of the ground and first floor plans. The vectors were subsequently transformed into faces that can be pushed and pulled into a 3D object. Other techniques, such as rotation and extrusion, were also useful for the construction of this model.

Following the main intention of communicating the formal arrangement of this building, the model was rendered in white to avoid any misrepresentation of its materiality, due to the lack of historical information and investigative studies regarding the Generalato's material composition in the studied timeframe. The height of the building, as well as the dimensions of doors and windows, were based on the information gathered from surveying the building's surviving parts.

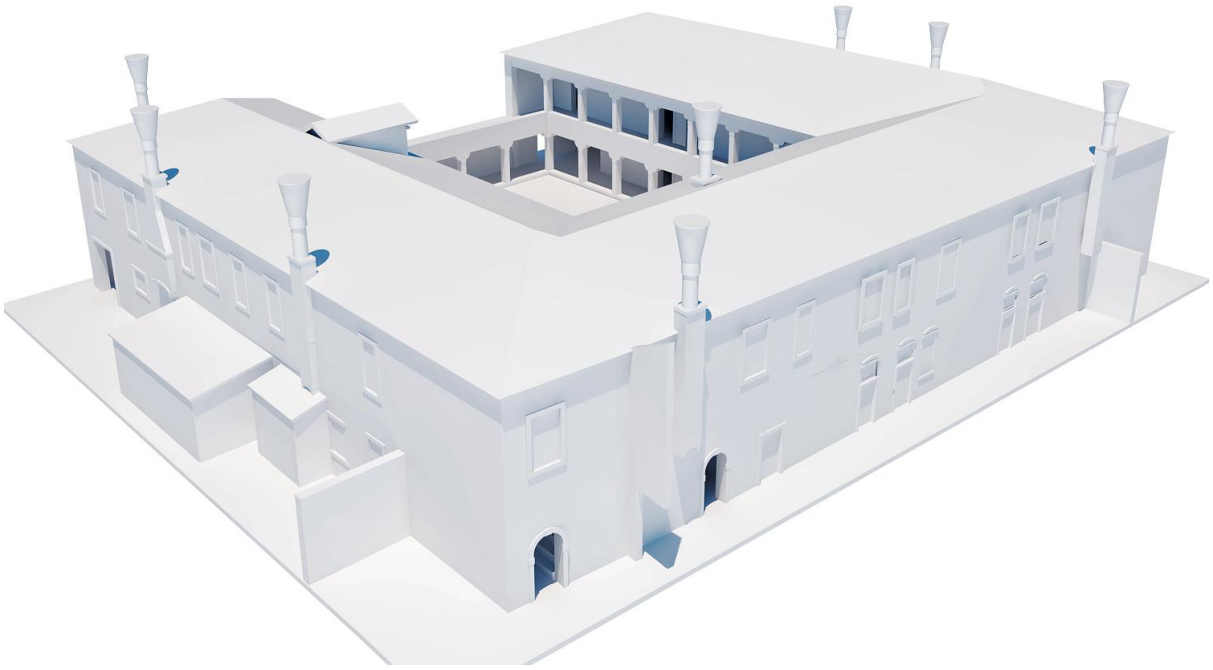

Figure 62. Digital reconstruction of the Generalato, views of west and south façades.

The reconstruction of the eastern façade, as mentioned during the floor plan analysis, results from logical reasoning derived from the *vedute* representations. The chimneys' placement mirrors that of the oldest traces in the western façade, striving for a sense of symmetry that could reasonably represent the presence of these architectural elements, considering the bedrooms for the *Baili* and the other high-ranking individuals would need a fireplace. It is possible to observe that the dormer projecting vertically from the sloping roof, which contains the window of the attic, was kept as it

exists today. Assumptions were made regarding the presence of a second dormer facing the existing one on the opposite wing, but ultimately the decision was made to not add it, as there are no records attesting to its existence. The two arched doors on the northern façade connected the cloister to the church, and this visualisation will be clearer later during the observation of the schematic model of the entire island.

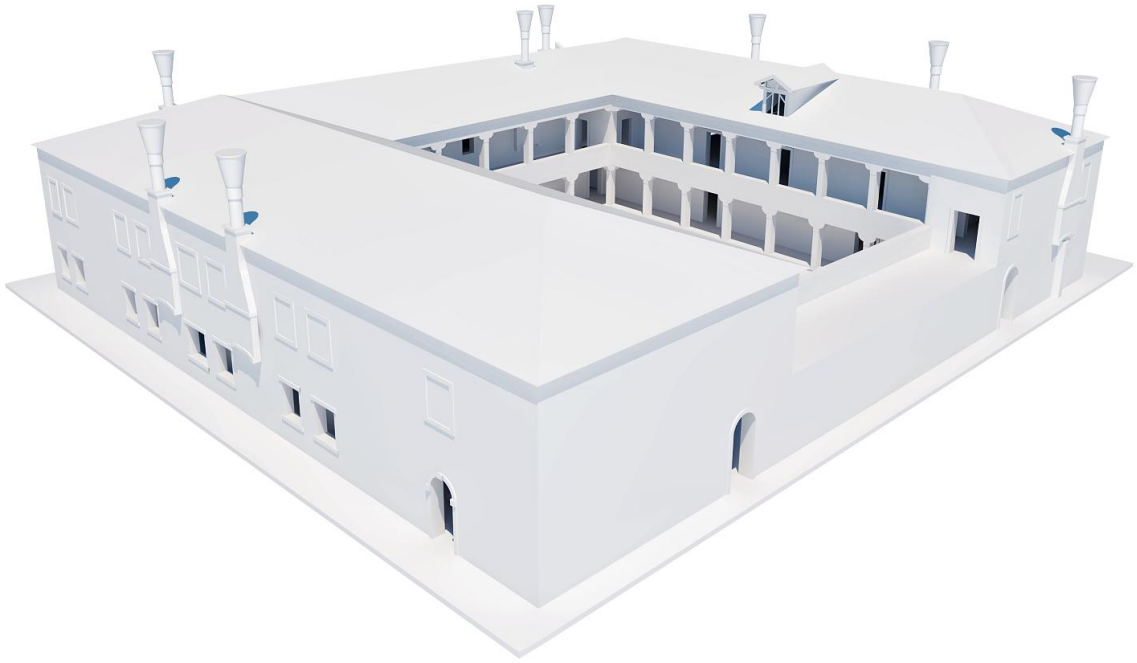

Figure 63. Digital reconstruction of the Generalato, views of east and north façades.

The AA' section was elaborated to display the terrace above the northern wing portico, adjacent to the church. It also cuts through the prominent room attached to the kitchen and allows for the visualisation of the interior columns represented by Manocchi. In the center, the difference between levels can be observed.

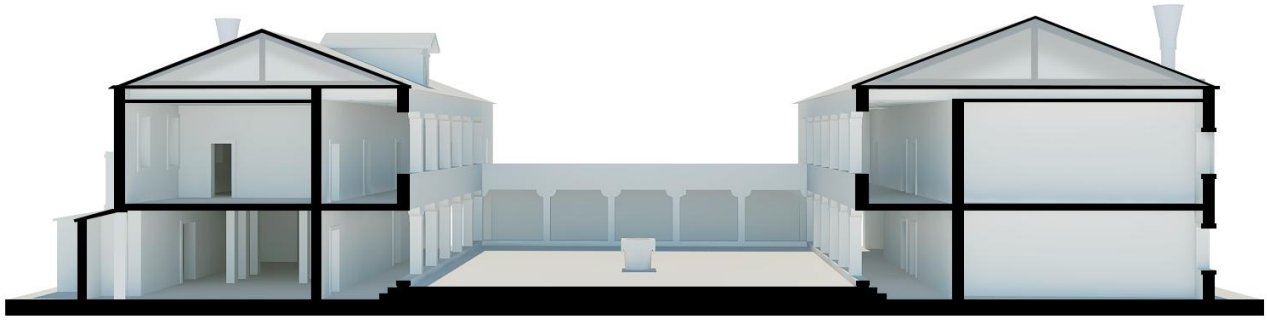

Figure 64. Section AA' of the Generalato's reconstruction.

An opposite view to the previous section is represented below, with the BB' section facing the inner part of the southern wing, the *Luoghi del Fondaco di Mezzogiorno*. The chimney breast, currently present in what remains of this façade, was represented in the model with the substitution of its upper part by a "campana" shape.

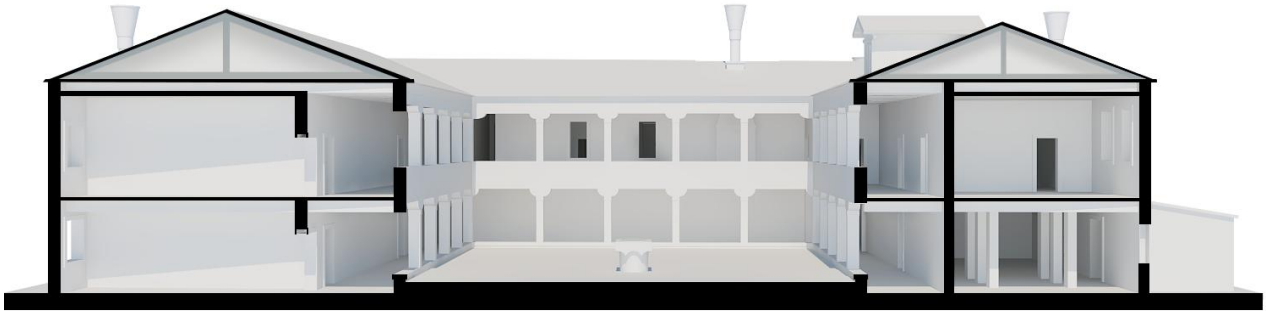

Figure 65. Section BB' of the Generalato's reconstruction.

The CC' section cuts through the aforementioned terrace, depicting the visual differences in elevation created by this architectural solution.

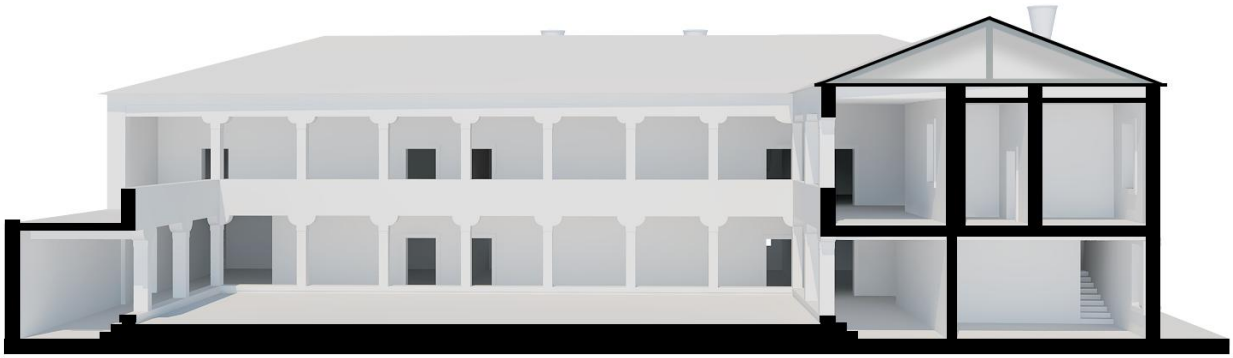

Figure 66. Section CC' of the Generalato's reconstruction.

Facing the opposite direction, the DD' section shows the only still-standing *loggia* and its relation with the rest of the cloister and building. Special attention was given to the door providing access to the terrace on the rightmost extremity of the first floor: not only was it represented in the drawing by Barletta and Fazzini (Fig. 55), but it has also been raised as an hypothesis for the currently existing crack in this part of the building—that is, the crack might have resulted from the infilling of this door.

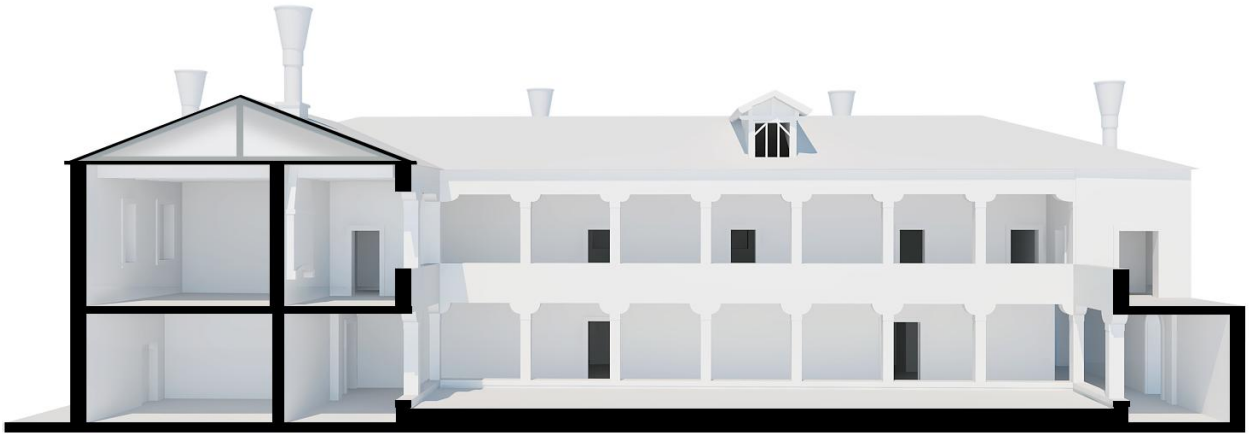

Figure 67. Section DD' of the Generalato's reconstruction.

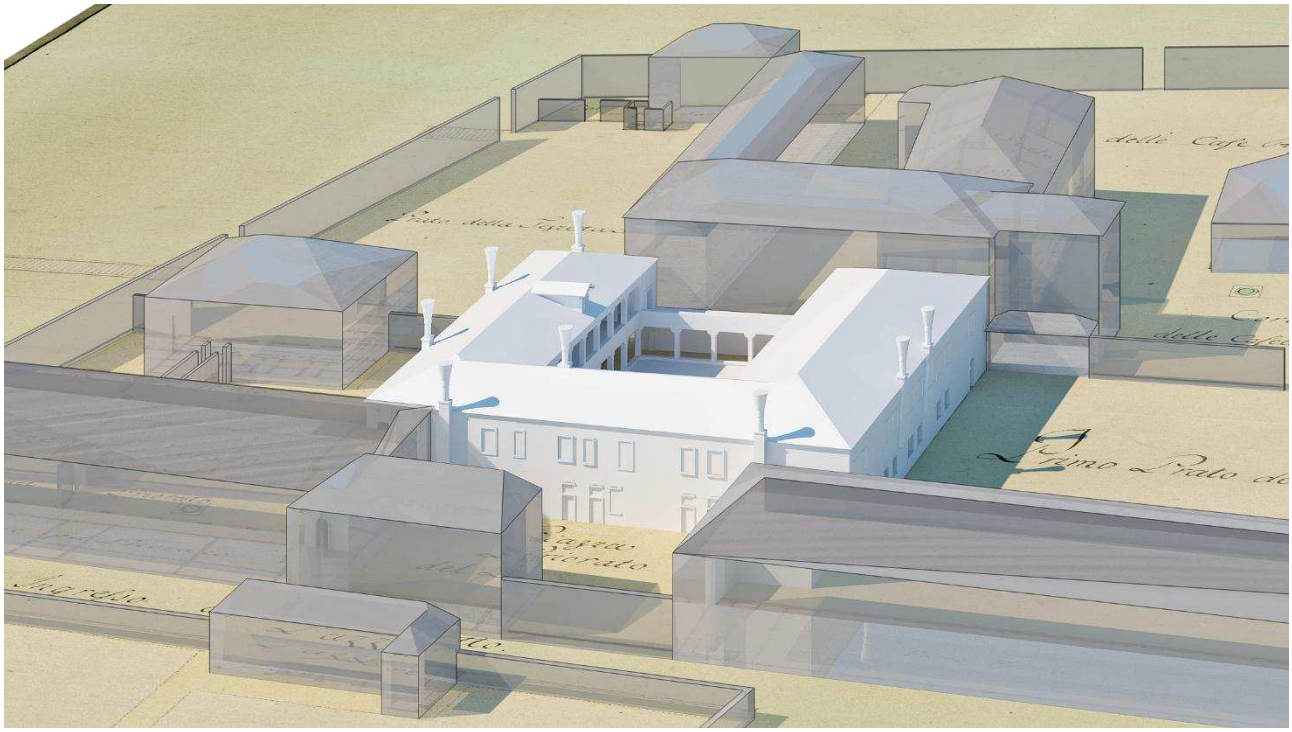

Figure 68. The Generalato reconstruction in context with a schematic volumetric representation of the Lazzaretto Vecchio complex.

5. Future challenges and investigations for building recovery

This chapter benefits from the valuable contribution of architect Giulia Passante and the structural engineers from the studio InTeA - Ingegneria Territorio Ambiente, who are currently involved in the recovery efforts for the Lazzaretto Vecchio complex.

The Generalato building, as well as the Contumacia al Morer, have been assessed to be at risk of collapse, posing a danger to the safety of workers and visitors on the island. At first, interventions to be carried out under "extreme urgency", as provided for by the Italian Procurement Code (*Codice degli Appalti*), should be executed before any restoration, aiming to avoid hazards.

Regarding the alterations to be carried out on the ground floor, one of the first interventions will be the clearing of vegetation from the former courtyard area, which has been entirely overtaken by excessive plant growth. In the covered passageway, the older shorings currently in place should be removed to allow the assembling of internal scaffoldings to pass through the space between the beams and continue toward the first floor. A ruined beam in the centre of the corridor, as well as a non-recoverable edge beam above the colonnades, should also be removed.

Figure 69. Shorings in the *loggia* of the Generalato.

On the first floor, the dismantling of stone elements and coverings, as well as the third (from left to right) pillar and capital—which are at risk of collapse—should be carried out in the colonnade, for subsequent reassembling after they have been repaired with stainless steel pins. The wooden planks of the floor should be removed prior to the demolition of the concrete floor and screed.

Figure 70. Covered passageway on the upper floor.

In the eastern façade, above the ground floor columns, the dismantling of the brick masonry was proposed, for the recovery of the material, prior to its reassembly with high-quality lime mortar. The overturning stone covers on top of the parapet of the upper floor should also be dismantled; however, each of the pieces should be numbered before dismantling, in order to record their original position.

It is important to point out that external scaffolding should not be anchored to the external façades of the Generalato. With this in mind, the groundwater level of the site should be checked, as the load-bearing capacity of the soil can be considerably reduced because of saturation. Geotechnical

surveys should be conducted, such as plate-load tests, to simulate the scaffolding loads and directly measure the soil's bearing capacity. The cone penetration test, a method used to determine soil properties and delineate soil stratigraphy, could also be employed to better understand the resistance of the soil. The assemblage of temporary work equipment such as scaffolds should follow the European Standards for performance and design required in the document EN 12811-1:2003.

Going further into the consolidation interventions that must be implemented on the ground floor, the non-recoverable edge beams should be replaced with new ones, designed with the same dimensions as the original elements, with larch wood prostheses covering the surfaces, aiming to avoid a visual disruption to the historical building. The new beams should also carry new support tablets above the capitals. Double-shaped plates in stainless steel should be installed to reinforce the wooden beams (Fig. 71). The rotating capital at the centre of the colonnade must be repositioned after the complete structural recovery.

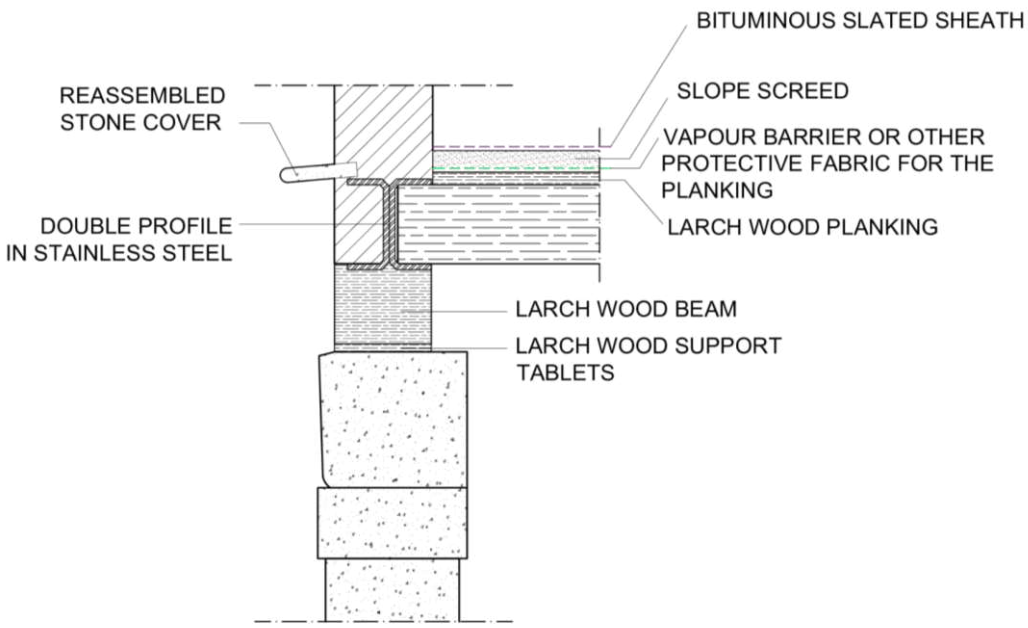

Figure 71. Constructive detail of the edge beam reinforcement. Adapted from InTeA - Ingegneria Territorio Ambiente.

The wooden beams that remain repairable should be promptly cleaned and restored. All beams should receive antiparasitic treatment, with particular attention given to those located in the attic. For the proper treatment, a quantitative and qualitative analysis of the microorganisms infesting the Generalato's wooden structures is deemed crucial, taking into consideration that each species' infestation might lead to specific biological attacks. Structural, chemical, and biological factors must

be properly determined prior to the choice and use of biocides, evaluating the microorganisms' sensitivity to the compounds commonly used as active ingredients in disinfectants, as well as the wooden elements' integrity and the biocides' potential impact on the wood's mechanical properties. According to the studies conducted by Koziróg *et al.* (2016, p. 2), the most common substances for the treatment of historical wood contain copper compounds, chromium, boric acid, azoles or quaternary ammonium compounds; and emerging research is also being conducted on ionic liquids and fatty acids for the protection of timber. Natural wood preservatives include essential oils, waxes, resins and tannins from bark, and extractives: their uses are mostly directed to the treatment of wood decay fungi, white and brown rot fungi, mold, termites, and insects (Khademibami *et al.,* 2022, p. 8).

On the first floor, new larch wood plankings, shaped according to the width of the existing ones, should be inserted above a batten framework and a new screed. The previously dismantled stone pillar, its capital, and the stone coverings should be reassembled in their original position.

The upper beam's exposed rebars should receive protective treatment to prevent their oxidation prior to the restoration of the concrete cover. Among the main categories of treatments are: barrier coatings made of epoxy, zinc, or polymers, that prevent moisture, oxygen, and chlorides from reaching the rebar's surface; calcium nitrite-based or organic corrosion inhibitors that can be applied directly to the rebar or mixed into the concrete; impressed current cathodic protection (ICCP), which consists of applying an electrical current to counteract the electrochemical process of corrosion; galvanic protection by sacrificial anodes made of zinc, magnesium or aluminium, which would corrode instead of the rebar (Kumar, 1998, pp. 325-341).

Following the aforementioned interventions of an urgent character, a series of diagnostic tests is recommended to further assess the integrity and characteristics of the construction materials. Sonic testing, a non-destructive method for the investigation of stone materials and bricks, could diagnose internal defects by transmitting sound waves through the masonry and measuring their velocity. The velocity of the sound waves, related to the density of the material and thus to its compressive strength, could reveal weathering patterns—key factors to be considered during the planning of the Generalato's retrofit (Dormany *et al.,* 2024, p. 61).

A detailed investigation of the historical masonry could be highly contributive for the conservation of the bricks, or even contribute to the development of new units for the replacement of the original ones considered to be too damaged. The characterisation of manufacturing processes and determination of the raw materials should also be deemed indispensable prior to the choice of the most appropriate conservation methods. One example of a possible, suitable consolidant of

weathering historical brick masonries is presented in the study by Guo *et al.* (2024, pp. 1-4): the alcoholic solution of barium hydroxide reacts with the silicate substrate of the bricks to form the BaSiO3 adhesive, which generates BaCO3 in the presence of water and carbon dioxide. These new products adhere well to the matrix and act as a cement that can bind loose weathered particles.

A resistograph could be employed to assess the structural integrity of the wooden elements by evaluating the wood grain and density, offering quantitative data to determine which original components could be preserved and which should be replaced. Considered the most appropriate for *in situ* investigation of ancient wood, this technology—considered semi-destructive—identifies the range and location of degradation by analysing the material resistance to various tools, such as drilling and screw withdrawal (Xue *et al.,* 2019, p. 250).

Penetrometer drilling tests, although more invasive and considered minorly destructive, can measure the strength of the historic mortars, and effectively identify areas of the building in more critical conditions that require priority restoration. By measuring the penetration depth of the device's steel needle in the bed joint, the results are used to estimate zones of degraded and weakened mortar (Łątka *et al.,* 2020, pp. 1-7). Furthermore, sampling of the various mortars dating to different building phases or interventions would provide qualitative analysis of the materials. The application of analytical techniques such as granulometric analysis, infrared spectroscopy (FT-IR), simultaneous thermal analysis (DSC/TG) and X-ray diffraction analysis (XRD) could be used to identify the technology referring to the typology of each sample, and indicate which parts of the masonry are more susceptible to deterioration based on the binders' composition (Biscontin *et al.,* 2002, pp. 31-36).

Different methods to clean corroded iron could be combined to obtain better results. Mechanical cleaning for the removal of layers of external corrosion must be carried out carefully to avoid further damage to the historical metal pieces. Among the common methods, vibrating needle probes and air-abrasive machines are known to be more delicate options. Moreover, chemical cleaning would allow the removal of all iron corrosion products, and cleaning solutions containing phosphoric acids, which form insoluble secondary and tertiary iron phosphates, is considered one of the safest methods, protecting the surface from further damage (Ribun *et al.,* 2022, p. 199).

Additionally, the restoration of the roof and drainage systems is emphasised as a critical priority in the initial phases of building recovery. The roof drainage system plays a vital role in safeguarding the structure by ensuring the efficient and rapid removal of water, provided by proper surface grading, sufficient discharge capacity, and the appropriate selection of roofing materials. To

prevent water infiltration and subsequent damage to the remaining structure of the Generalato, the roof drainage system should be repaired according to specific maintenance programs, depending on the discharge capacities, faults, and the climatic conditions prevailing in the environment, to be determined after a study of their characteristics (Tavukcuoglu *et al.,* 2007, p. 2699).

As previously mentioned, the several decades of neglect have significantly contributed to the present state of deterioration at the Lazzaretto Vecchio complex. The most crucial incentive for the survival and continued use of the buildings on the island, ensuring its long-term preservation, is the implementation of regular and systematic maintenance. In the forthcoming National Archaeological Museum of the Venice Lagoon, the ground floor of the Generalato will be repurposed to house the museum's ticket office, bookshop, restrooms, and restaurant, while a guest house is planned for the first floor (Passante, 2020, p. 64). Future architectural and structural studies could contribute to the effective revitalisation of this building, balancing its historical legacy with the demands of contemporary use and the island's new cultural role.

6. Conclusion

By tracing the transformation of Lazzaretto Vecchio from a medieval Augustinian monastic complex into the world's first institutionalised plague hospital, this detailed and multidisciplinary study culminated in the development of a digital reconstruction of the Generalato. The model adheres closely to the dimensions derived from the surviving remains of the building, with the missing parts reconstructed through systematic analysis of a wide range of historical, archival and iconographical sources. Establishing a clear and rigorous chronology of the island's architectural transformations reveals the inherent challenges and complexities of digitally representing a building—as it once stood prior to its partial demolition—that was continuously altered and modified throughout its history.
The extensive damage assessment of the current structural anomalies, conducted using advanced digital tools, enhances the understanding of the targeted interventions required to address each identified issue. This groundwork lays a solid foundation for future conservation and restoration strategies. Moreover, this thesis aims to move beyond conventional approaches to analysing building decay, offering concrete insights by interpreting historical context, material properties, and the risks posed by improper restoration using incompatible materials and techniques. Urgent interventions necessary to the building's preservation were outlined, along with a proposed set of priorities to guide future efforts.

The digital documents produced in this thesis are intended to serve as critical tools for the documentation and investigation of architectural heritage. They also contribute to the broader discourse on preserving culturally significant structures that have been deformed and neglected. Virtual reconstruction enables the visualisation of previously existing configurations, helping to illuminate the long-term processes—whether natural or human-induced—that led to their deterioration. The potential of this emerging technique to interpret and communicate the history of built heritage represents not only academic advancement but also a practical resource for public engagement and education.

Finally, this thesis makes a meaningful contribution to the ongoing discourse on cultural heritage preservation, emphasising the importance of integrated methodologies in architectural research. By intertwining historical investigation with technological innovation, the study provides deeper insight into the understanding and recovery of a relevant structure in a non-invasive manner. It proposes valuable frameworks for future research on both the Lazzaretto Vecchio island and the Generalato building, with the potential for these methodologies to be adapted and applied to other understudied or at-risk heritage sites.

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Censo stabile, *Mappe austriache*, *Giudecca e isole*, plate no. 10

I.R. Magistrato di sanità marittima, b. 60.

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