

Tabarca Building Renovation Project: A Historical Perspective in Genoa's Port

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Abstract

The revitalization of long-disused sites with a focus on production activities is a critical endeavor for the preservation and integration of such sites into the urban fabric, a challenge that Italy also confronts. Buildings once deemed "modern" are now key markers of local historical and economic evolution, yet the process of their revitalization demands both careful study and practical solutions. Any effort to adapt these structures must balance conservation with modern functionality, ultimately hinging on the broader theme of restoration and reuse. The Tabarca Building in Genoa serves as a paradigmatic case in point, given its profound cultural significance for both the city and the nation. It was the inaugural facility in Italy to incorporate refrigeration technology for the preservation of goods, a groundbreaking innovation in the early 20th century that profoundly reshaped global commerce and gave rise to new architectural forms. Despite its notable legacy, the full potential of the Tabarca Building remains largely underappreciated. This paper demonstrates that restoration and repurposing work on this historic warehouse highlights the importance of forward-looking interventions, ensuring heritage buildings remain both relevant and respectful of their unique characteristics and surrounding context.

Keywords: Architectural Engineering, Adaptive Reuse Strategies, Maritime Architectural Heritage, Integrated Multidisciplinary Approach, Traditional Building Techniques

1. Introduction

The transformation of decommissioned industrial areas into spaces integrated within the modern urban fabric represents one of the most complex and stimulating challenges for contemporary architecture. The process of repurposing such areas is particularly critical in port zones, which retain significant historical and industrial heritage. With the advent of the post-industrial era, many of these spaces have undergone a gradual decline, raising urgent questions about their redevelopment and reactivation. In Italy, as in the rest of Europe, the renewal of these areas not only addresses the challenges of urban decline but also presents an unprecedented opportunity to reimagine the use of built heritage and promote more sustainable and inclusive territorial planning [1].

In Europe, cities such as London, Liverpool, and Hamburg serve as emblematic examples of port area transformation. In London, Canary Wharf stands as a significant example of profound territorial renewal: while some historic buildings were preserved for museum purposes, most pre-existing structures were demolished to make way for a new financial district. The process of urban regeneration radically transformed the area, leaving only the docks as remnants of the original conurbation. The connection between the industrial past and the new financial district is therefore primarily intangible, marked by the continuation of the area's production vocation [2]. In stark contrast, other cities have opted for a more conservation-focused approach to regenerating their port areas. Liverpool's Albert Dock and Hamburg's Speicherstadt are excellent examples of how historical memory can be preserved through targeted repurposing interventions that respect the existing urban fabric. These sites, listed as UNESCO World Heritage Sites, effectively demonstrate how industrial heritage can be valued and integrated into the contemporary urban landscape [3, 4].

50 In Italy, the transformation of decommissioned port spaces poses a critical challenge for urban planning in major
51 coastal cities. Genoa, the second-largest Italian port by cargo traffic [5], offers a striking example. Historically, the Port
52 of Genoa has always been the city's beating heart, significantly influencing its urban development. The first major urban
53 reconversion and port space reuse initiative materialized with the project coordinated by architect Renzo Piano for the
54 Old Port (Porto Antico) during the 1992 Expo, held to celebrate the 500th anniversary of the discovery of America.
55 This intervention transformed the Old Port area into a vibrant urban center, combining new constructions such as the
56 Piazza delle Feste and the Genoa Aquarium with the restoration of monumental structures such as Porta Siberia and the
57 Palazzine del Porto Franco, as well as the repurposing of abandoned warehouses like the Cotton Warehouses
58 (Magazzini del Cotone) and the Millo Building [6].

59 The successful transformation of the Old Port inspired, in subsequent years, the redevelopment of the Darsena, a
60 previously decommissioned port area whose urban recovery process is still ongoing. Originally developed at the end
61 of the 19th century, the modern Darsena functioned for decades as a vital logistics hub for goods arriving at the Port of
62 Genoa, yet it remained isolated from the surrounding urban context despite its central location within Genoa's historic
63 center. Despite numerous proposed redevelopment projects, many of which were never realized [7], the area's revival
64 began only in 1995 with the opening of the Faculty of Economics and Commerce in the Scio District, designed by
65 architects Aldo Pino and Aldo Luigi Rizzo. This intervention emulated the success of the Faculty of Architecture
66 redevelopment by Ignazio Gardella, which had already initiated a virtuous regeneration process in Genoa's historic
67 center. The area subsequently benefited from further interventions, such as the transformation of the Galata District
68 into the Museum of the Sea and Navigation in 2004, designed by Guillermo Vázquez Consuegra, and the conversion
69 of the Cembalo District into residential spaces in 2005, executed by Enrico Bona. Despite these developments, some
70 structures remain abandoned, highlighting the persistent challenges in urban redevelopment processes [8]. Among
71 these, the Tabarca District, built at the end of the 19th century as the site of Italy's first refrigerated warehouse, is an
72 example of significant historical value awaiting adequate recovery. A historical and typological analysis is essential to
73 appreciate not only the building's history but also its potential for transformation within the current urban context.

74 This study aims to examine the Tabarca building using a methodological approach that integrates multiple scales
75 and disciplines, exploring its topographical context and historical, economic, and functional aspects. The objective is
76 to provide a comprehensive overview of the building by analyzing its location within Genoa's urban fabric, its historical-
77 functional context, its current state, and the ongoing repurposing project. This investigation aims to highlight the
78 historical legacy of the Tabarca District and offer a model for the recovery of similar structures in Italian and European
79 port cities.

80 81 **2. Methodology**

82 The conservation of historic buildings always requires following a precise interdisciplinary approach, which means
83 following a method. The concept of a "methodological approach" means following specific phases in sequence and
84 interacting with each other, then allowing an intervention to the building without creating information gaps that could
85 then compromise the result. It is a fundamental theme that cannot be avoided in the knowledge, intervention, and
86 valorization of buildings.

87 The object of this study, the Industrial complex of Tabarca, presents itself simultaneously as a single element and as
88 part of a contextual complex (the Darsena), which must be understood in all its aspects: historical, functional, geometric,
89 and topographical. Without this framework, it would also be difficult to implement an authentic restoration project and,
90 above all, enhance the property's characteristics. In line with this aim, a team of specialists examined the various aspects
91 of the property in an integrated manner. This approach involved integrating multiple surveys, each conducted with its
92 own precise methods.

93 Firstly, the contextual and topographical framework was defined, since, as mentioned, the building cannot be
94 understood as a "white elephant" but as part of an essential historical economic system, such as the Genoese Darsena.
95 Then, an analysis of the historical features was carried out, as the Tabarca building is a fundamental emblem for the
96 history of cold storage; the analyses concerned a targeted study on the functional system that was crucial also to compare
97 with other similar structures to deduce their origins and models; this research has mainly acted through bibliographic
98 and archival funds. Lastly, the work included an analysis of the current state, involving a technical construction
99 assessment of the structural condition, the state of conservation, and a geometric survey.

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3. Discussion and results

3.1 Historical Development of the Darsena Area

The industrial archaeology building that is the subject of this study does not represent an isolated architectural element separated from its context; on the contrary, it is part of an important organic system of multi-layered buildings born in response to common and connected policies. The context in question is the Genoese port of Darsena (Fig. 1).



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Figure 1 – Satellite image of the Porto Antico area of Genoa (on the left); general view of the Darsena area with indication of the Tabarca building (on the right). (Source: Google Earth, elaboration of the Authors).

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112 The maps and historical documents were fundamental for this purpose. The area was used as a port from the end of
113 the 13th century. From this moment, its history and growth officially start [9-11].

114 During the 15th and 16th centuries, the layout of the area was planned in a more specific way by the Consuls of the
115 Municipality of Genoa: in the north-west side there is the arsenal, in the central side there is the "Darsena delle Galere"
116 and in the south-east side the "Darsena del Vino", the latter is divided from the previous part thanks to a north-south
117 pier. This moment coincides with a period of great prosperity for the maritime republic of Genoa.

118 In the 17th century, a slight modification was documented in the area between the Arsenale and the Darsena delle
119 Galere. In this part, a large structure characterized by a series of arches was inserted, probably used as warehouses and
120 workshops (Fig. 2).

121 Military use was the primary vocation of the place, and as a consequence, the arsenal and the military services were
122 the key points for the area. The context maintained its characteristics unchanged until the end of the 18th century. The
123 area continued to be divided into the Carenaggio Darsena, the Galee Darsena, where galleys for both military and
124 commercial use were moored and the Arsenale, where the galleys were equipped for war [12].

125 In 1870, the municipality of Genoa obtained the transfer of the Darsena, which brought about a radical
126 transformation. In fact, in 1873, the area was converted to commercial use and definitively lost its military value. This
127 event is responsible for the subsequent construction of the Tabarca building, the subject of this study, and many other
128 transformations in the area. In 1889, a comprehensive project to arrange the area was approved. The Tabarca, which is
129 part of this scheme, was built between 1895 and 1898 [13].

130 In addition to this building, warehouses, and neighborhoods were built that took their names from the Genoese
131 colonies: Cembalo, Scio, Galata, Metelino, Caffa, and Farmagosta (destroyed to make way for the Sopraelevata). The
132 modifications continued after the First World War, when there was a need for more space. To facilitate this, the series
133 of works to raise the buildings began in 1921.

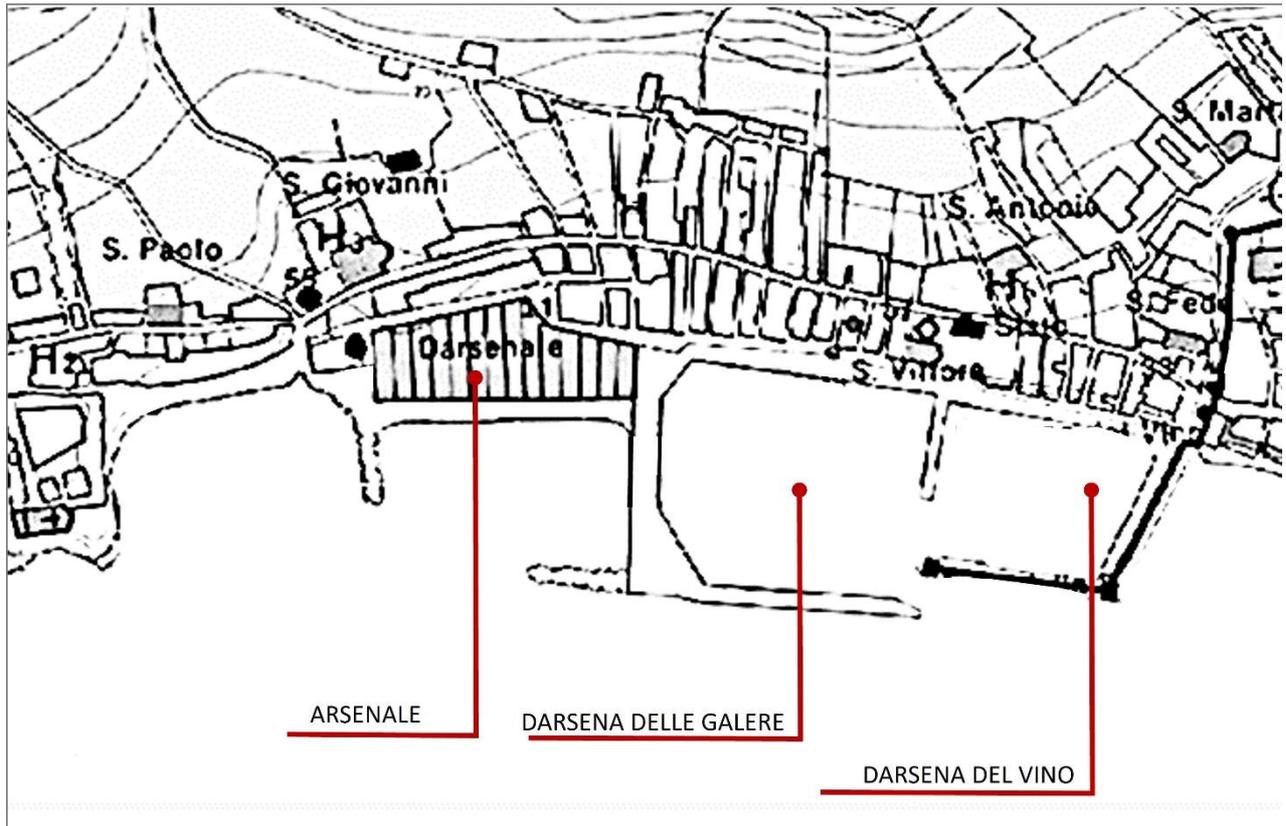


Figure 2 – Darsena area in the 15th century. (Source: Elaboration by the authors).

134 An important moment for the Tabarca building came in 1923 when the Municipality of Genoa signed an agreement
135 with the Società dei Magazzini Frigoriferi Genovesi for the raising of the Scio district and the installation of a new
136 Frigorifero to replace the one in the Tabarca district. From this moment on, the structure took on the main connotation
137 that would characterize it until the present day and that also connects it to the other structures, all of which were
138 designed to fulfil the same purposes and destinations [14].

139 In conclusion, examining the history of the single building and the entire context (Fig. 3), as briefly described, two
140 important phases can be summarized: the first, of a military nature; the second, of an economic nature. The building
141 subject to this study falls within this second phase, which should be seen not only as a single structure but also as part
142 of an organic system. This system has made the Genoese Darsena unique in terms of its characteristics, history, and
143 composition [15].

144 3.2 Historical Framework of the Building Typology

146 At the start of the 20th century, the Quartiere Tabarca assumed a distinct role within the Genoese port as the site of
147 Italy's first refrigerated warehouse dedicated to food storage [16]. Examining the state of the refrigeration industry
148 during this period is crucial to understanding how engineering disciplines tackled the challenges presented by this
149 innovative building typology. Such an analysis sheds light on the structural and technical features of the Quartiere
150 Tabarca.

151 Interest in industrial refrigeration began in the 19th century, particularly in its latter half, with the invention and mass
152 production of early refrigeration systems. These systems relied on cooling achieved through the compression and
153 expansion of specific refrigerants. Initial technologies used ammonia and sulfur dioxide due to their ability to liquefy
154 under pressure. However, ammonia was gradually phased out because of its corrosive properties and health risks.
155 Alternatives such as carbon dioxide and methyl chloride, though safer for humans, introduced technical challenges due
156 to the high operating pressures required [17].

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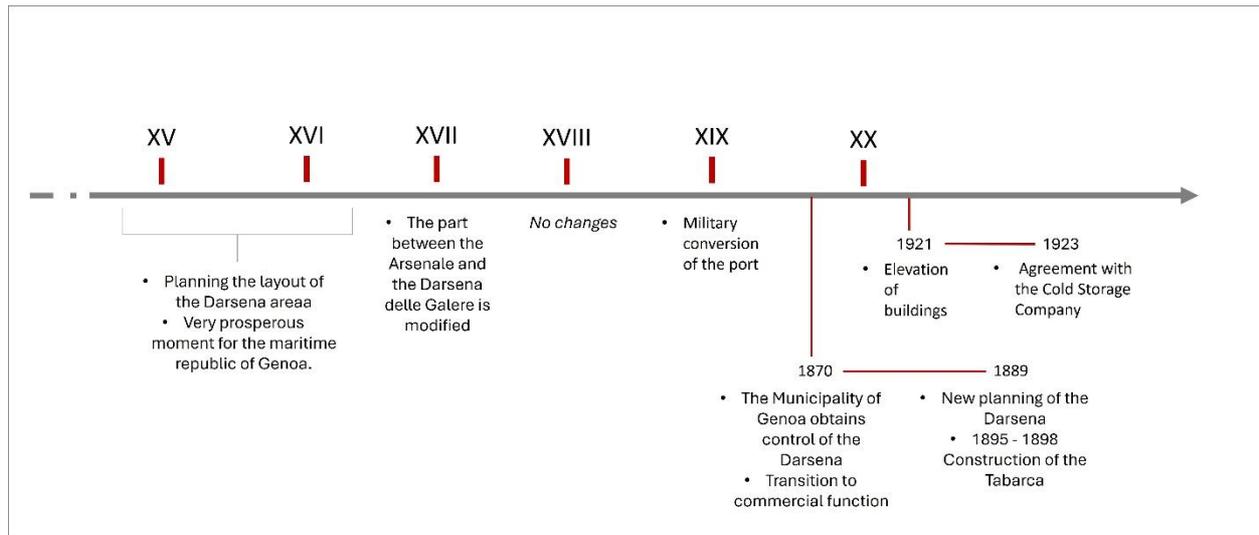


Figure 3 – Timeline of the main events that characterize the historical evolution of the Darsena and the building known as the Tabarca. (Source: Elaboration by the authors).

158 Various methods were employed to cool storage rooms. One involved piping refrigerant gases directly into the
 159 storage areas, offering high efficiency but posing risks of gas leakage that could harm both stored goods and personnel.
 160 Another approach utilized refrigerants to cool a non-freezing liquid circulated through coils along the ceilings of storage
 161 rooms. This method required forced ventilation to prevent frost accumulation, which could disrupt optimal
 162 environmental conditions for food preservation [18]. A third technique used brine solutions to cool air circulated into
 163 storage rooms through wooden ducts. This method capitalized on convective airflows driven by density differences
 164 between hot and cold air [19].

165 The construction of refrigerated warehouses necessitated the adoption of novel building techniques to achieve
 166 unprecedented performance levels. Insulation materials became critical, selected for properties such as resistance to
 167 moisture, non-flammability, and resistance to pests. Early methods involved creating air gaps between cold storage
 168 rooms and exterior walls using lightweight bricks known as "voids" (Fig. 4a). Subsequently, cork elements, particularly
 169 corkboard, were used to fill wall cavities, though this approach proved costly and difficult to implement [18]. This
 170 challenge led to the development of compressed cork panels patented by Grunzweig and Hartmann of Ludwigshafen.
 171 Marketed under the brand "Reform," these panels were praised for their ease of installation and mechanical reliability,
 172 making them suitable for insulating floors and roofs. Alternative materials included pumice, peat, vegetable or mineral
 173 charcoal, often used in loose form as fillers for vaulted ceilings. Advances in insulation materials also enabled
 174 lightweight construction of cold rooms using timber frames combined with insulation layers and external claddings
 175 (Fig. 4b) [20].

176 Flooring materials in cold rooms were selected for durability, waterproofing, and ease of cleaning. Asphalt was
 177 initially used but was later replaced by cement-based screeds, offering higher mechanical performance. Linoleum,
 178 patented in the 19th century, provided another option, offering ease of maintenance, though it remained more expensive
 179 than cement-based alternatives [18]. Roofs in masonry cold stores typically consisted of metal I-beams supporting solid
 180 brick vaults, topped with a lightweight concrete layer mixed with cork or peat for improved thermal performance. The
 181 interiors of cold rooms were finished with washable cement plaster or enamel coatings, with enamel more common in
 182 English-speaking regions.

183 Doors and windows in cold storage facilities were designed for airtight sealing, with wooden doors large enough to
 184 accommodate foodstuffs. Lighting solutions varied between European and American contexts. French, British, and
 185 American cold stores lacked natural lighting (e.g., Lyon Cold Storage, Villette Factory), whereas German facilities
 186 incorporated natural light to meet hygiene standards. Well-lit environments facilitated thorough cleaning, which was
 187 challenging under artificial lighting at the time due to the limitations and maintenance costs associated with
 188 incandescent bulbs. Alternatives like oil or gas lamps were unsuitable as they altered internal climatic conditions.
 189 Natural lighting in German facilities was achieved using reinforced glass panes with metal meshes to enhance
 190 mechanical strength—a technique that gained popularity in early 20th-century Central Europe [19].

191 Ventilation was another critical aspect in cold store design, essential for preventing food spoilage, condensation, and
 192 mold during periods of system inactivity. To address these issues, the "Schwarz device" was introduced. This device
 193 comprised a metal cylinder with threaded plugs, including an insulated outer plug. Natural rubber gaskets ensured
 194 airtight sealing, while a metal grille prevented insect or unauthorized entry [21].

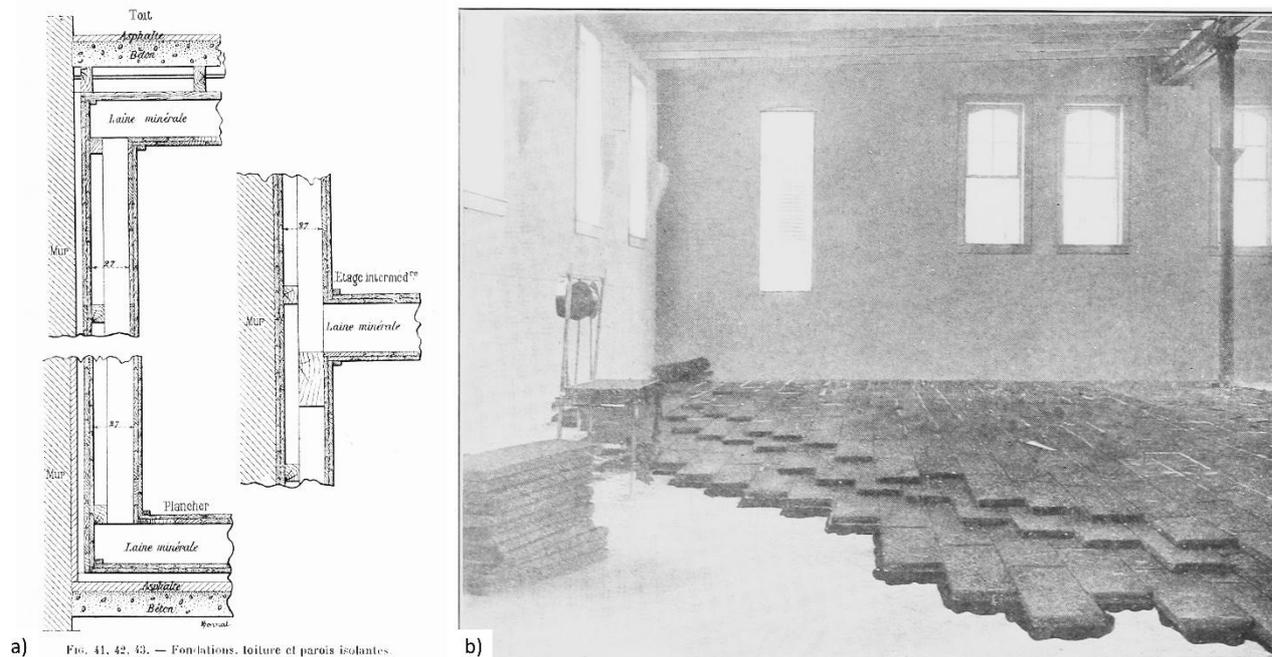


Figure 4 – Technical solutions for the construction of cold rooms: a) Schematic section of a masonry cold room; b) Construction of a cold room with a cork-based insulation system. (Source: Fig. 4a from [18]; Fig. 4b from [21]).

195 To contextualize the techniques used in constructing cold stores, it is essential to examine the development of the
 196 refrigeration industry in Europe and Italy. At the beginning of the 20th century, the global evolution of refrigeration
 197 was marked by significant heterogeneity. The United Kingdom played a leading role, establishing itself as a pioneer in
 198 constructing refrigerated port warehouses and developing one of the first commercial fleets equipped with refrigerated
 199 environments [21]. In the UK, the growth of manufacturing industries facilitated the commercialization of ammonia-
 200 based and, later, carbon dioxide-based refrigeration systems. These advancements enabled applications ranging from
 201 transporting frozen meat to early scientific research in laboratory settings. One notable example was the Baerselman
 202 Cold Storage facility on London's Southbank, one of Europe's first large-scale cold stores [22].

203 Notably, the Genoa cold store, located in the Quartiere Tabarca, was Italy's first refrigerated warehouse. Established
 204 in 1901 by the Società Anonima dei Magazzini Frigoriferi Genovesi, the facility became operational in April 1902 and
 205 underwent significant expansion in 1906 [16].

206 The Genoese cold-storage depot featured rooms distributed across four levels, interconnected via an internal
 207 staircase and an electric lift system. A single corridor illuminated by windows facilitated access to the cold rooms.
 208 These windows were located exclusively at the junctions, as the cold rooms themselves lacked natural light. Instead,
 209 visibility within the storage areas relied entirely on electric lighting. Insulation materials included cork, applied as loose
 210 fill for the roofs and as panels for the floors and perimeter walls. In cold rooms requiring lower temperatures (-6°C),
 211 additional insulation was achieved using mineral wool, then commercially known as Cotton Silicate [23].

212 The facility's refrigeration system, manufactured in England by F&Hall of Dartford (UK), utilized carbon dioxide
 213 technology with a total capacity of 45,000 refrigeration units per hour [18]. This system supported 32 cold rooms,
 214 designed to store various foodstuffs with a total volume of 6,500 cubic meters, maintaining temperatures between -7°C
 215 and 2°C [24].

216 In 1926, in response to growing demand for refrigerated storage, the Quartiere Scio, also located near the docks, was
 217 repurposed for this purpose, effectively replacing the Quartiere Tabarca. As a result, the refrigerated facilities in the
 218 Quartiere Tabarca were gradually dismantled, and the area was repurposed for general storage without specific

219 temperature requirements [24].

220

221 3.3 Existing Conditions

222 The Quartiere Tabarca exhibits structural and functional features typical of late 19th-century industrial buildings.
 223 The structure rises four stories, with each level internally divided into six sections (Fig. 5a), separated by masonry load-
 224 bearing walls. The façades present a regular arrangement of openings, creating a consistent visual rhythm (Fig. 5b).
 225 The southeastern and northwestern elevations are currently plastered and painted, whereas the northeastern façade
 226 remains unfinished.

227 At present, all extensions facing Via Lercari and part of Via Rubattino have been demolished, though some remnants
 228 of surface finishes can still be found on the north-west elevation. Meanwhile, the southeastern façade retains a steel
 229 canopy that has suffered significant deterioration due to oxidation of its metal components and the complete lack of
 230 maintenance throughout the 20th century.

231 The flat roof has been repurposed to accommodate shared technical installations serving both the building itself and
 232 adjacent structures. Internally, most ground-floor units have independent access from the exterior, and some feature
 233 internal mezzanines. These are composed of hybrid timber-steel trusses, which are directly anchored to the building's
 234 structural masonry. Vertical circulation is provided by staircases made from a combination of timber, steel, and
 235 reinforced concrete, which have undergone significant degradation, as evidenced by the pronounced warping of the
 236 supporting beams.

237 On the upper floors, access is provided by a stairwell and an elevator, both located at the southernmost section of
 238 the last bay. The horizontal circulation on each level is organized around a central corridor running along the eastern
 239 side, from which individual rooms are reached (Fig. 5c).

240 The former layout of the cold storage areas is now challenging to discern. Still, their former presence is indicated by
 241 several large, hermetically sealed wooden doors that once connected these spaces to adjacent rooms (Fig. 5d).



Figure 5 – From top left to right counterclockwise: a) longitudinal section of the building; b) south-east view from Via Lercari; c) corridor on the east side of the building; d) interior wooden doors. (Source: Authors).

242

243 Inside, the upper floors remain unfinished, revealing the load-bearing masonry. The masonry follows a striped
 244 construction technique, consisting of horizontal layers of solid bricks alternated with squared stone courses measuring
 245 approximately 85 cm in height (Fig. 6a). The stone material, known as Promontorio stone, was widely employed in
 246 Genoese architecture and quarried in the Sampierdarena area [25]. Like the primary metal beams, the walls incorporate

247 granite stiffening elements, enhancing their connection with the horizontal structural framework.

248 At the surface level, the walls exhibit widespread deterioration, with clear evidence of multiple modifications over
249 time. The presence of replastering, inconsistencies in surface finishes, and areas of renewed, restored, or removed
250 coatings reflect the numerous interventions carried out on the building during the 20th century, none of which resulted
251 in a comprehensive restoration. Additionally, window frames have been partially replaced.

252 Beyond the absence of plaster and unfinished surfaces across much of the upper two floors, other visible signs of
253 masonry deterioration include flaking, discoloration, peeling, and cracks in the plasterwork. The cracks, particularly
254 concentrated on the ground floor, are likely due to settlement in the masonry structure.

255 The load-bearing masonry is supported by intermediate floors composed of metal girders, upon which brick vaults
256 are constructed (Fig. 6b). The area above the vaults was originally filled with a lightweight cast mixture based on lime
257 and pozzolanic aggregates. A 3–5 cm thick lime screed was then applied over this layer, followed by the final flooring.
258 The building features a variety of floor types, differing in materials and structural patterns, each contributing to its
259 historical significance. Notably, some sections of what is believed to be the original flooring remain intact within the
260 Tabarca factory, consisting of 8 cm thick stone tiles (Fig. 6c).



Figure 6 – From left to right: a) masonry with courses of brick and Promontorio stone with the granite padstone where the floor beam ends; b) vaulted ceiling with metal joists; c) floor made with limestone elements. (Source: Authors).

261

262 *3.4 Reuse and conversion design project*

263 The proposed reuse project for the Tabarca building is designed to address the client's functional needs while
264 integrating contemporary architectural, technological, and infrastructural innovations. The intervention seeks to
265 enhance energy efficiency, seismic safety, and social functionality, ensuring cost-effective management and
266 maintenance while prioritizing the historical preservation of the structure.

267 The building will be repurposed as an Advanced Maritime Training Center for students of the Italian Merchant
268 Marine Academy. The restoration project was executed using Building Information Modeling (BIM) in full compliance
269 with current regulations (Fig. 7a).

270 The ground, first, and second floors will be dedicated to academic and training activities, while the third floor will
271 accommodate student residences designed according to current regulations, with multi-functional spaces balancing
272 educational and residential needs. The distribution of spaces is based on the need to preserve the material and spatial
273 integrity of the historical structure while implementing necessary functional adaptations. The architectural approach
274 respects the original layout of Tabarca, minimizing demolition while optimizing spatial organization. The circulation
275 layout is designed for clarity, accessibility, and spatial continuity.

276 At the ground floor, navigation simulators will be installed in dedicated classrooms. These high-tech systems
277 replicate ship operations, enabling trainees to simulate real-world conditions, including port entries and exits in
278 digitized maritime environments (Fig. 7b). To enhance teaching effectiveness, mezzanine levels have been introduced
279 in the simulation classrooms, allowing instructors to observe training activities from an elevated perspective.

287 The design of the interventions was driven by the intent to respect the historical building and enhance its original
 288 structure. New partitions constructed using drywall systems are fully reversible, thereby preserving the integrity of the
 289 building's original spatial configuration. Particular attention was devoted to the conservation and enhancement of the
 290 original masonry arches along the corridor, achieved by inserting lightweight partitions designed to emphasize these
 291 features through the integration of seating elements and transparent panels (Fig. 8a). This approach not only safeguards
 292 the existing architectural components but also reinterprets them with new functions and renewed significance.
 293 Similarly, new internal claddings were introduced where required to accommodate technical systems; these were
 294 conceived with the same guiding principle, contributing to a balanced dialogue between preservation and innovation
 295 (Fig. 8b). An additional reversible intervention, in line with the building's conservation constraints, involved the use of
 296 non-invasive partition walls limited to a height of 2.70 meters (Fig. 8c). These elements integrate building services
 297 while enabling flexible layouts for furnishings and equipment, all without compromising the original masonry.

298 The flooring follows a continuous system, blending with existing historical surfaces and enabling spatial
 299 reconfiguration through the repositioning of lightweight partitions. For the slab, a conservation-based approach is
 300 adopted. This involves cleaning vaulted surfaces and steel beams to remove deteriorated materials while preserving the
 301 structural integrity of the brick vaults. If necessary, mechanical removal techniques will expose the original structural
 302 components, restoring their aesthetic and functional integrity (Fig. 8d).

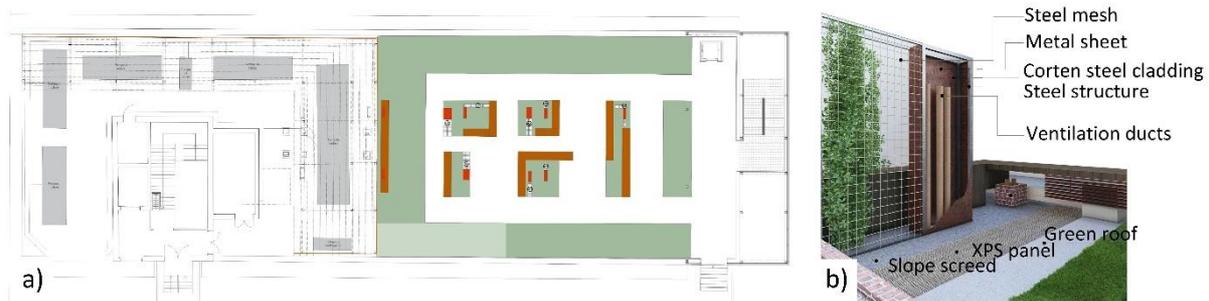


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304 Figure 8 – Clockwise from top left: a) exploded axonometric view and detail of the lightweight partition system positioned beneath
 305 the original arches; b) internal cladding system for the routing of electrical, plumbing, and HVAC services; c) low partition wall for
 306 service line passage; d) conservative restoration of banded masonry and floor system with brick vaults and steel beams, shown in a
 307 before-and-after comparison. (Source: Authors).

308 The functional reconfiguration of the Tabarca building culminates in the adaptive reuse of the rooftop. This area will
 309 be accessible to the public and will feature a green roof and photovoltaic panels, underscoring the project's commitment
 310 to environmental sustainability (Fig. 9a). The design sought to reconcile the goal of creating a usable space with the
 311 need to accommodate both existing and newly installed building systems. To this end, specific mitigation strategies
 312 were implemented, including the shielding of air handling units (AHUs) and drainage columns through corten steel
 313 cladding and steel framing systems (Fig. 9b). This approach aims to reestablish the material dialogue that characterizes
 314 the structural reinforcement interventions on the lower floors.

315 The intervention meets key regulatory requirements for seismic and fire safety. The seismic strategy preserves the
 316 building's spatial layout by reinforcing foundations, strengthening existing structural openings, and upgrading localized
 317 slabs. For fire safety, a major issue was ensuring proper evacuation routes, resolved by adding a transparent glass
 318 enclosure on the north façade containing an independent steel-framed emergency stairwell. The addition improves
 319 safety while remaining reversible and architecturally integrated.



320
 321 Figure 9 – From left to right: a) roof plan: on the right, the accessible area highlighted in color; on the left, the service zone dedicated
 322 to mechanical systems; b) mitigation system for drainage columns and internal ventilation units, along with the roof assembly and
 323 stratigraphy. (Source: Authors).

324 4. Conclusion

326 The study has highlighted the historical and technological significance of refrigerated warehouses, a rare yet highly
 327 relevant typology in the evolution of industrial architecture between the late 19th and early 20th centuries. These
 328 buildings exemplify the integration of mechanical systems with architectural design, incorporating innovative
 329 construction solutions to ensure high thermal insulation performance and compliance with hygienic and sanitary
 330 requirements. Within this framework, the Tabarca building emerges as a particularly significant case, not only as the
 331 first refrigerated warehouse built in Italy but also for its strategic location within the Darsena of the Port of Genoa.

332 The original spatial configuration of the building has facilitated its adaptive reuse as an Advanced Maritime Training
 333 Center for the Italian Merchant Marine Academy. The generous interior spaces have allowed for the integration of
 334 student accommodations and dedicated areas for high-tech navigation simulators, ensuring that the new function aligns
 335 seamlessly with the building's maritime heritage.

336 The Tabarca reuse project serves as a model for sustainable repurposing of industrial heritage, contributing to the
 337 revitalization of an area already characterized by academic institutions. The intervention demonstrates the feasibility
 338 of a rehabilitation strategy that effectively balances technological innovation with heritage conservation, offering a
 339 replicable approach for the adaptive reuse of historical structures in port and industrial settings.

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348

349 6. Authors Contributions

350 Although the research conducted and presented in this contribution is unified, the Authors individually assume
351 editorial responsibility for the text, as follows: Salvatore Polverino for paragraphs 1 and 3.2; Lucrezia Longhitano for
352 paragraph 2 and 3.1; Giuliana Sciacca for paragraph 3.3; Santi Maria Cascone for paragraph 4; and paragraphs 3.4
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