

ABANDONED BARRACKS AS URBAN VOIDS. REUSE AND REGENERATION IN THE ITALIAN CASES OF LUPI DI TOSCANA AND SANTA CATERINA¹

LOS CUARTELES ABANDONADOS COMO VACÍOS URBANOS. REUTILIZACIÓN Y REGENERACIÓN EN
LOS CASOS ITALIANOS DE LUPI DI TOSCANA Y SANTA CATERINA

FEDERICO CAMERIN ²
RAFAEL CÓRDOBA-HERNÁNDEZ ³

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2 Doctor en Arquitectura
Investigador post-doctoral Ramón y Caja. Departamento de Urbanismo y Representación de la Arquitectura,
Escuela Técnica Superior de Arquitectura de Valladolid
Universidad de Valladolid – Instituto Universitario de Urbanística, Valladolid, España
<https://orcid.org/0000-0002-8659-3761>
federico.camerin@uva.es

3 Doctor en Arquitectura
Profesor Contratado Doctor, Departamento de Urbanismo y Representación de la Arquitectura,
Escuela Técnica Superior de Arquitectura de Valladolid
Universidad Politécnica de Madrid, Madrid, España
<https://orcid.org/0000-0001-7878-2055>
rafael.cordoba@upm.es

Esta investigación aborda los factores determinantes para desencadenar la reutilización de los cuarteles militares abandonados en Italia, un tema relativamente poco estudiado comparado con otros vacíos urbanos, así como el impacto de la reutilización en términos de regeneración urbana. Centrándose en dos casos ubicados en las ciudades de Florencia y Verona, los resultados de este análisis, basado en una metodología cualitativa y trabajo en terreno, ponen de manifiesto la complejidad y desafíos de los procesos de reconversión, que refleja las dificultades y avances logrados en cada caso. La caracterización de ambos procesos permite indicar las causas principales que han influenciado las acciones de regeneración urbana (prolongado abandono, cambio de titularidad en la propiedad, financiación estatal y enfoque integral), además de otros elementos, como el gran coste económico de las operaciones, que pueden impedir que estos desarrollos se conviertan en edificaciones sostenibles e integradas en la ciudad.

Palabras clave: áreas suburbanas, cuarteles militares, uso del suelo, reurbanización, desarrollo sustentable

This research examines the determining factors that trigger the reuse of abandoned military barracks in Italy. This topic, as well as the impact of reuse on urban regeneration, has been relatively understudied compared to other urban voids. Focusing on two cases located in the cities of Florence and Verona, the results of this analysis, based on a qualitative methodology and fieldwork, highlight the complexity and challenges of the conversion processes, reflecting both the difficulties and progress achieved in each case. The characterization of these processes allows identifying the leading causes behind urban regeneration initiatives, including prolonged abandonment, changes in ownership, state funding, and a comprehensive approach, among others. It also highlights other elements, such as the significant economic cost of operations, which may hinder these developments from becoming sustainable buildings that are integrated into the city.

Keywords: suburban areas, military barracks, land use, reurbanization, sustainable development

I. INTRODUCTION

The conversion of military installations to civilian uses can trigger urban regeneration processes in areas that go beyond physically, symbolically, and socially separating these spaces from their surroundings (Balarezo-Alberca, 2024). In the case of barracks, intended for the accommodation and training of soldiers, these are areas that occupy a large swath of land, constituting a specific typology of urban emptiness.

Although the international literature has mainly addressed the conversion process for national and local urban policies (Peric & Miljus, 2021) and specific topics such as urban development and heritage (Jevremović et al., 2021), few studies have analyzed the factors that contribute to generating the new uses (Szabó et al., 2025). Italy, among other countries, is a notable case in the literature, primarily due to the significant influence that military barracks have had on the expansion and urban planning of many cities (Floris, 2024). Many of the conversion initiatives, especially in Italy, have been superficially analyzed (Spanu, 2023), as, when evaluating them, both in the implementation phase and regarding the results obtained, the triggers for the successful implementation of the conversion processes have not been identified, which has hindered the understanding of urban regeneration issues (Camerin, 2021).

That is why this article focuses on the physical-spatial analysis of the old “Lupi di Toscana” and “Santa Caterina” barracks, located in peripheral areas of the Italian cities of Florence and Verona, respectively, and their conversion processes to civilian uses. The primary objective is to identify, through the analysis of these two experiences and the application of a qualitative methodology, the triggers of their transformation and the tools used to implement urban regeneration in these peripheral areas.

By addressing the conversion of two barracks, the article participates in the field of urban regeneration research in three ways. Firstly, it presents an internationally applicable methodology for comparative analysis of urban voids. In the field of urban studies, most of the research has focused on individual case studies, with few comparative analyses of barracks conversion (Camerin, 2024). Secondly, an approach based on the systematic analysis of primary and secondary sources, combined with fieldwork and archival research, is proposed. Finally, two conversion projects pending implementation are evaluated to broaden knowledge about the issue at hand, which has been barely analyzed by the authorities (Commissione 4 Difesa, 1999).

II. THEORETICAL FRAMEWORK

With the end of the Cold War, a shift in the role that the Armed Forces should fulfill in the 21st century began to emerge. Thus, the countries that were part of NATO and the Warsaw Pact underwent a gradual rationalization process of their armed forces, which involved a reduction in personnel and a decrease in occupied territory. This rationalization was also due to national budgetary revision policies aimed at reducing public debt (Adisson & Artioli, 2020). As a result, the progressive abandonment, underutilization, and dismantling of military real estate assets, including airports, warehouses, shooting ranges, barracks, and powder magazines, were observed. It was estimated that, globally, more than 8,000 military facilities were dismantled, covering approximately one million hectares (Bonn International Center for Conversion [BICC], 1997: 2). This phenomenon was accompanied by domestic conversion programs such as those launched in the United States and France by *Base Realignment and Closure* (Clanahan, 2021) and *Mission pour la Réalisation des Actifs Immobiliers* (Piganiol, 2022) respectively. On the other hand, in countries such as Spain, only specific closures were decreed (Camerin & Córdoba Hernández, 2023), while one of the few studies that analyzes several conversion cases is that of Bagaeen and Clark (2016).

Although the first transfer program was launched in Italy in 1997, a severe lack of global vision was detected in both the state and local public debates regarding its relationship with territorial planning policies (Camerin, 2022). In light of the absence of a public census of the change of the military presence at a national level (Romano, 2017), it is especially complex to classify cases of reuse as a driving force of urban regeneration. Even so, there is evidence of old facilities that have undergone spontaneous re-naturalization processes, gradually turning them into potential ecological corridors (Ellwanger & Reiter, 2019).

The old barracks and their conversion management are considered a specific typology of “urban emptiness” (Berruete-Martínez, 2017), that is to say, not only as a deteriorated space, but as a complex figure, loaded with potential meanings — historical, identity, or social - that can play a transformative role in urban regeneration processes. Camerin and Córdoba Hernández (2024) underlined their complexity, given the reintroduction of barracks into the city’s socio-economic system. This implies interdisciplinary approaches for the recovery of both open and built military spaces, based on the conjunction of architectural, economic, social, and urban aspects that coexist to alter the pre-existing relationship between the previously impassable military areas and their role in the current city. Therefore, their functional and spatial reintegration would require specific actions to balance the relationship between their historical and patrimonial permanence and the existing fabric (Dekel, 2021),

which makes new uses compatible with contemporary social needs, especially in terms of endowments that guarantee local social reproduction (Balarezo Alberca, 2020).

These spaces, built in Europe between the 19th century and the Second World War, share constructive quality, a discreet state of conservation, and an amplitude and modularity of the built spaces that allow implementing a wide range of new roles that preserve the existing architecture, as pointed out by Turri and Zamperini (2017), despite the difficulties inherent to their reuse. Similarly, their rationally defined and standardized layouts, equipped with wide open and green spaces, initially intended for circulation and training, have the potential to become true “cities within the city,” featuring tree-lined avenues and squares (Turri et al., 2008). However, Cacciaguerra and Gatti (2009) point out the existence of a trend in the dual management of abandoned military heritage: military architectures built before 1900 are considered as “cultural heritage” and are treated as a material heritage of military architecture to enhance improvement through rehabilitation, while barracks built between 1900 and 1950 are usually treated differently, since they are perceived as buildings of little architectural value, so their demolition is commonly accepted. Military historical heritage should be handled differently, rather than being demolished to make room for new morphological conformations that are suitable for the needs of 21st-century society.

III. CASE STUDY

The choice of cities and barracks is based on several similar characteristics that help make a comparative analysis based on four common elements:

- Free transfer of the ownership of the “Lupi di Toscana” (2015) and “Santa Caterina” (2016) barracks to the Municipalities by the Ministry of Defense, through the *demaniale federalism* mechanism.
- Peripheral location and size greater than 100,000 m² are considered an indicator of the potential for transformation.
- Preparation of Master Plans for the conversion. Both documents decreed transformative urban projects that involved modifying local urban planning instruments. In the case of Florence, the Modification to the General Urban Planning Plan placed the barracks in a broader scope of

transformation that involved other non-built-up areas around it, covering a total area of 200,000 m². For its part, the master plan for the Santa Caterina barracks has not yet been integrated into local urban planning instruments. However, it was considered within the territorial project for the city’s candidacy for Italian capital of culture in 2022.

- Beneficiaries of state funding of the “Innovative National Program for Quality of Life” ⁴ national call, whose objective is to reduce the lack of affordable housing, regenerate the socio-economic fabric of the field of action, in addition to improving accessibility, functionality, and safety of abandoned and degraded spaces. Faced with a planned total cost of €200,000,000 for the Lupi di Toscana barracks and approximately €27,000,000 for the Santa Caterina barracks, the 2021 resolution allocated subsidies of 16% (€32,410,759) and 55% (€15,000,000), respectively, for works that should be completed by 2026.

The Lupi di Toscana barracks occupy approximately 102,015 m² in the southwestern periphery of Florence (Figure 1). It spans approximately 33,000 m², situated around a large central green square, comprising 26 buildings. Inside the enclosure, a hydraulic power plant and a 25m-high, 80 m³ concrete water tower stand out. Conceived as isolated and monofunctional U-shaped pavilions, organized in groups of three on both sides of the large central square, the barracks are one of the best examples of functional military architecture in Italy, characterized by a search for maximum ventilation and sunshine. Despite their valuable morphology, these elements have suffered prolonged neglect, resulting in drastic deterioration. In their immediate surroundings, there is vacant land and fragmented residential areas, as is often the case in many other Italian urban peripheries, along with three key attractors of activity: the “Ponte a Greve” shopping center, the “San Giovanni di Dio” Hospital, and a Rehabilitation and Healthcare Center. Accessibility to the city center is guaranteed by public transport thanks to the tram, although the area is subject to traffic congestion at peak hours.

For its part, the Santa Caterina barracks occupies 226,000 m² on the Veronese periphery, southeast of the urban center, between the banks of the Adige River and the Milani canal (Figure 2). This settlement is divided into two contiguous constructions: a heritage-protected Vauban-type fortification of 126,000 m², built between 1850 and 1852 as part of the city’s broader fortification system that, between 2013 and 2020 was the

⁴ “Programma Innovativo Nazionale per la Qualità dell’Abitare” (<https://www.mit.gov.it/comunicazione/news/pnrr-assegnati-28-mld-per-il-programma-pinqua-sulla-qualita-dellabitare-il-40-va>).

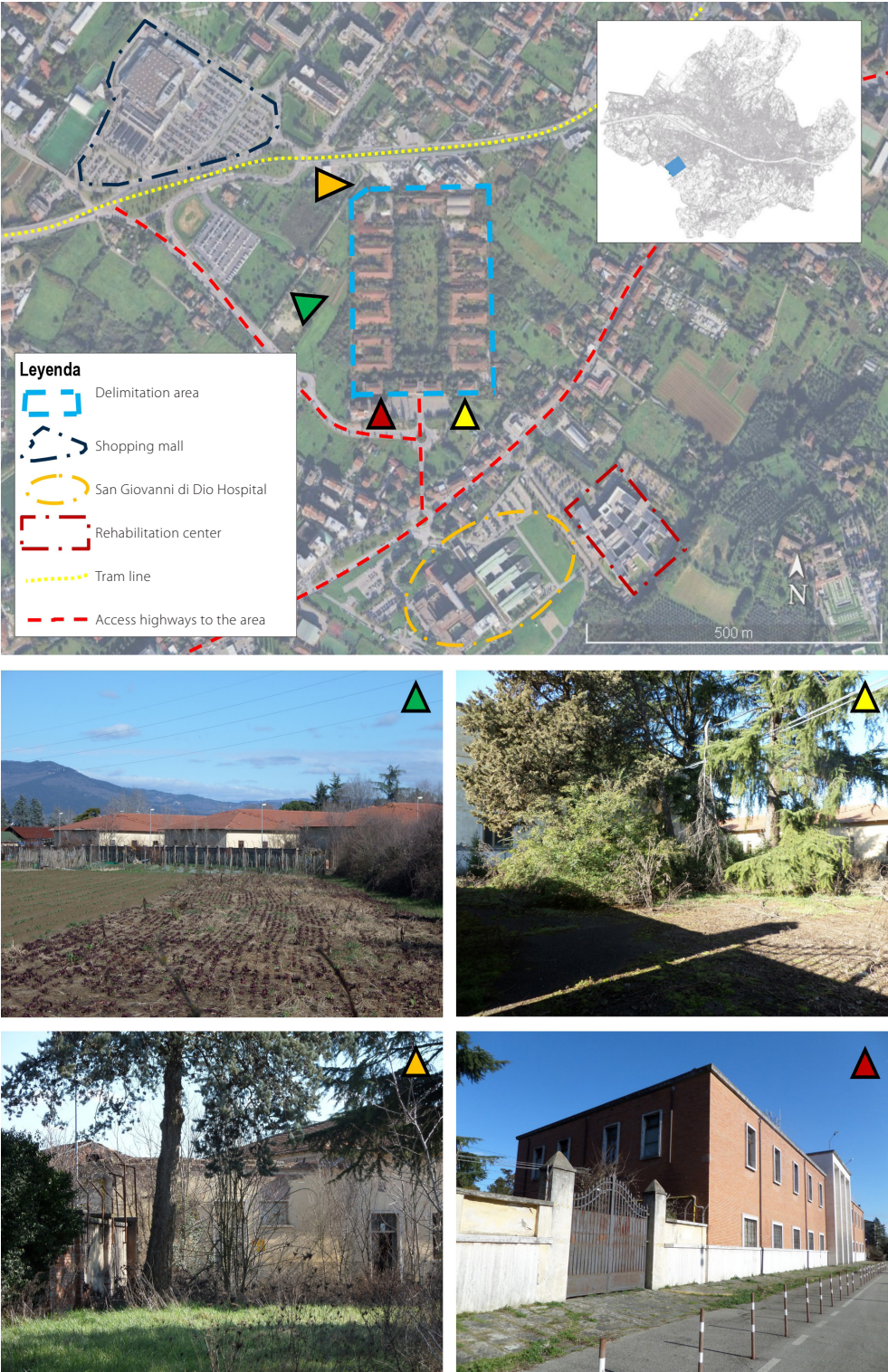


Figure 1. Walkable catchment of the Lupi di Toscana barracks and photos of the area. Source: Prepared by the authors (2025).



Figura 2. *Walkable catchment* of the Santa Caterina barracks and photos of the area (a: fortification, b: barracks). Source: Prepared by the Authors (2025).

Variables	Lupi di Toscana Barracks	Santa Caterina Area	
		Fortification	Barracks
Plot size	102,015 m ²	126,000 m ²	100,000 m ²
Built surface	33,000 m ²	2,700 m ²	77,920 m ²
Buildings	26	2	30
Year of construction	1941-1947	1850-1852	1950
Year of underutilization	1995	1970-1997	1997
Year of abandonment	2008	1997	2008
Year of transfer	2016	2013	2016
Number of buildings	26	2	30
Listed buildings	Military Command Building	All	None
Type of morphology	Functional	Vauban-type fortification	None
Temporary reuse	No	1998-2005 and 2013-2020	No
Public participation process	Yes	No	
Average rental and sale prices of homes at a city and area level	City rent: €14.18/m ² City sale: €4,316/m ² Local rent: €14.98/m ² Local sale: €3,763/m ²	City rent: €11.54/m ² City sale: €2,583/m ² Local rent: €9.73/m ² Local sale: €1,957/m ²	
Cost of the works	€200,000,000	€27,000,000	
Public financing	€32,410,759	€15,000,000	

Table 1. Case studies information. Source: Prepared by the authors (2025).

headquarters of the “Operafortefestival”⁵ cultural initiative; and the 100,000 m² and 77,920 m² barracks, built during the 1950s, and distributed in 30 non-listed buildings without any formal distribution. Around it, there are open spaces accompanied by a company, the *Monastero di Clausura Serve di Maria Oblate Sacerdotali*, and a residential area of 30,000 m² under construction⁶ in 2024. Although the area has a bus transport system that ensures connection with the urban center, the transport infrastructure favors the private motorized vehicle as the primary mode of mobility.

IV. METHODOLOGY

At the methodological level, the qualitative perspective enables the analysis of the interrelation between both cases and their immediate surroundings, allowing for an independent

exploration of their adaptation to civil use projects. For this, in October and November 2024, semi-structured interviews were conducted to 5 people for each case study (the local town planning councilor, two town planning professors from the local universities and two citizens representing the local associations), accompanied by direct observation, through a field study in each case study⁷ and an in-depth documentary analysis of primary and secondary sources (historical cartography, territorial planning, legislation, and press) in the historical archives of the two municipalities.

The primary data for the barracks are presented in Table 1, along with a brief description of the context, using the concept of *walkable catchment*⁸, as well as a valuation proposal based on the 10 aspects proposed by Ricci et al. (2022). These indicators have been chosen as they propose evaluating qualitatively how the conversion of urban voids can trigger a process of urban regeneration and sustainable development.

⁵ Evento de teatro, cine al aire libre y música en vivo celebrado cada verano, organizado por una organización sin ánimo de lucro (*Ippogrifo Produzioni*), en colaboración con el Ayuntamiento (<http://www.operaforte.it/>).

⁶ <http://www.viveresantacaterina.it/>

⁷ The work consisted of a visit to each barracks in December 2024 (without being able to enter their premises for security reasons) and its surroundings independently, taking photographs and notes on the characteristics of urban environments.

⁸ It consists of identifying the functions located around a certain point within a 5-minute walking radius.

Variables	Lupi di Toscana Barracks	Santa Caterina Area
Local and supralocal governance	1	1
Public participation	2	0
Sustainable mobility	2	1
Preservation of the existing environment	1	1
Compatible/integrated conversion	2	2
Historical and heritage issues	1	1
Social aspects	2	0
Public facilities	2	1
Common goods	1	1
Renewable energy use	1	1
Total	15/20	9/20

Table 2. Aspects of conversion processes. Source: Prepared by the Authors

Using these indicators provides a comprehensive and multidimensional view of sustainable urban development across various key aspects. This helps consider whether reuse projects of abandoned spaces only physically transform the areas, or if they generate positive impacts on social, economic, and environmental levels. To achieve this, the 10 aspects mentioned above were analyzed and summarized in Table 2, where each one receives a score ranging from 0 to 2: a score of 0 indicates the absence of significant improvements or changes, while a score of 2 represents substantial advances in the integration of these elements.

V. RESULTS

The study highlights the complexity and challenges of the conversion processes, which reflect the difficulties and progress achieved in each case. Both barracks have experienced a prolonged period of underutilization and abandonment, from the mid-1990s to the present, a symptom of the difficulties in coordinating state interests (economic and national defense) with local needs.

One of the distinctive aspects of the development of these projects was the bottom-up approach in the decision-making process, which played a crucial role before the creation of the Master Plan. This participatory process was called "Not housing but City 2.0". The participation took place between April and June 2016, through three dissemination days, 18 interviews with groups of residents, two focus groups, laboratories in eight classes between primary and secondary schools, and three

public events (one of presentation, one of a walk, and another of co-design), which involved more than 600 people.⁹ On this basis, an International Competition of Urban Design¹⁰ Ideas was convened to create a new residential settlement (October 2016 to July 2018). Despite the failed hypothesis of converting the old military compound into a mosque in 2017, the winning project of 2018 aimed to demolish all the constructions, except the Command Building, and build 53,000 m² distributed in social housing of 3 to 5 floors (36,501 m², 68% of the total), tertiary use (6,000 m²), tourist accommodation (4,499 m²), commercial use (4,000 m²) and industrial-artisanal use (2,000 m²) (Figure 3). On the other hand, in Santa Caterina, a top-down approach was employed, where the citizenry was not directly involved, which negatively impacted the social acceptance of the proposed transformation. In this case, the 2021 Master Plan for its conversion considered demolishing the barracks and rehabilitating the fortification, with the creation of a public park exceeding 8 hectares (Figure 4). Its objective was to provide a unified space to store documentation by creating a new urban center dedicated to culture and leisure time, which would save the City Council €340,000 per year in storage costs. The barracks spaces would feature a new 16,000 m² L-shaped building for the municipal archives, local foundations, and civic museums, in addition to the construction of three residential buildings totaling 2,600 m². The elaboration of the Master Plan at the end of 2020 has favored the debate around its content, but without considering the community's participation in the decision-making process.

Both projects foresee infrastructures for sustainable mobility. In Florence, a new system of bicycle lanes is planned that will

⁹ <https://open.toscana.it/web/noncasemacitta2.0/home>

¹⁰ <https://concorsolupiditoscana.comune.fi.it/>

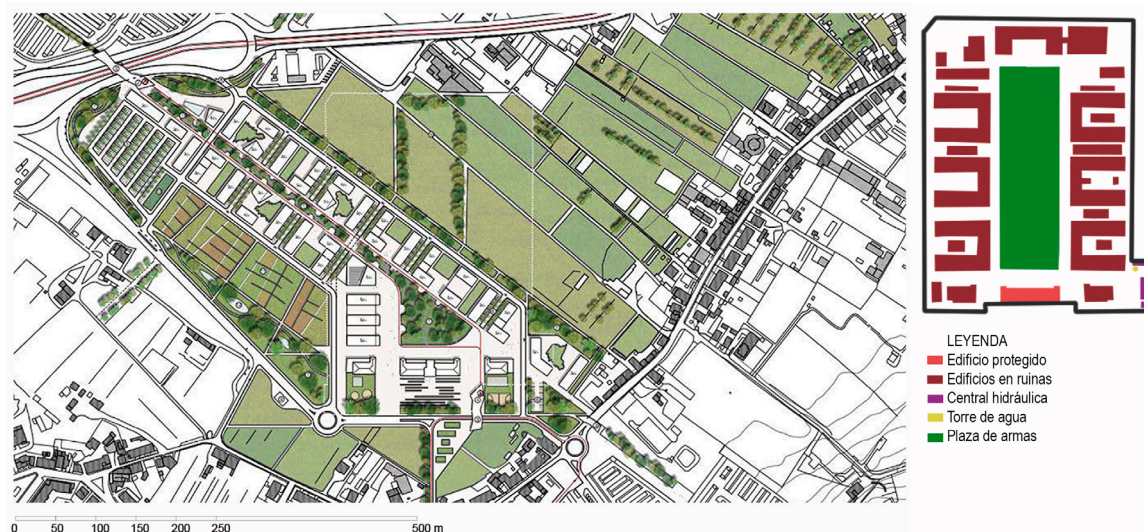


Figure 3. Planimetry of the Lupi di Toscana barracks (above) and the proposal of the Master Plan (below). Source: Prepared by the Authors based on the material provided by the City of Florence.

connect with the existing cycling and pedestrian network, which will run around the perimeter of the intervention area, and a modular “on-demand” self-driving system of approximately 450 m in length that crosses the central axis of the barracks to reach the tram stop. A perimeter ring road is also made to allow the connection of the area with the existing mobility system. The project for the Santa Caterina barracks only provides some bicycle lanes within the intervention area. At the same time, there is no plan to strengthen the public transport system or sustainable mobility to connect the old barracks with the rest of the city.

In both, a differentiated approach is observed in terms of landscape preservation and the use of natural and anthropic resources. Although the original military architectural structures will not be preserved, both projects pay special attention to the natural component, which favors the creation of large green areas. In the case of the Lupi di Toscana barracks, a complex green structure is proposed that includes 22,487 m² of green belt parallel to the bike path and pedestrian perimeter to the intervention area, a park of 55,912 m² that stems from the recovery of much of the green areas within the barracks compound, a 16,000 m² linear central park that crosses the central part of the new building and the urban gardens of 13,204 m², with a total of more than 100,000 m² of green spaces. On the other hand, the second case will focus on preserving existing green areas and adding more than 80,000 m² of parkland.

As for the integrated and complementary roles, both cases introduce substantial changes to the original morphology of their spaces. The intervention at the Lupi di Toscana barracks is presented as an “urban surgery” project, which seeks to integrate social housing with commercial, cultural, and recreational uses by creating a new urban fabric. On the other hand, the conversion of the other barracks will involve the demolition of most of the existing buildings, replacing them with an L-shaped structure intended for archives and cultural purposes, while preserving the green areas, which also means a significant change in the space’s dynamics.

Regarding the enhancement of the historical and documentary heritage, both choose to preserve the architectural heritage partially. In the Lupi di Toscana barracks, the Military Command Building, declared a cultural interest site in 2014, will be maintained. In contrast, only the historical fortification in the Santa Caterina barracks will be preserved¹¹. However, neither of the projects contemplates the preservation of military memory, which could be interpreted as a loss of the historical identity of these spaces. Social inclusion is another aspect considered. In Florence, the characteristics of social housing have not yet been specified, and it remains unclear whether social housing will be available in the Santa Caterina barracks. Additionally, there is no data available on sale and rental prices. In October 2024, the average rental and sale prices of homes in Florence¹² are €14.18/m² and €4,316/m²,

¹¹ <http://www.ifortiassociazione.com/index8.html>

¹² <https://www.immobiliare.it/mercato-immobiliare/toscana/firenze/>

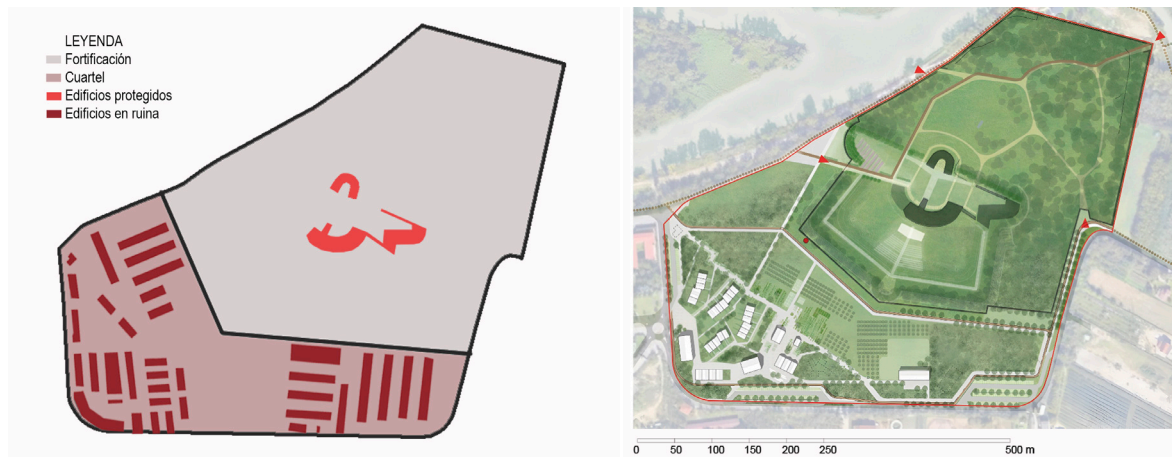


Figure 4. Planimetry of the Santa Caterina area (above) and the proposal of the Master Plan (below). Source: Prepared by the authors based on the material provided by the Verona City Council.

respectively. While in the area of the Lupi de Toscana barracks¹³, these figures reach €14.98/m² and €3,763/m², respectively. In the case of the Santa Caterina barracks¹⁴, the rental and sale prices of its area are €9.73/m² and €1,957/m², respectively, which are lower than the city's average¹⁵ of €11.54/m² and €2,583/m².

As for the public facilities, the Lupi di Toscana barracks will focus on offering a wide range of cultural services in the Command Building, including an auditorium, library, coworking spaces, and areas for creative and hands-on craft activities. Meanwhile, the conversion of the Santa Caterina barracks, although less defined in this area, aims to create a new cultural centrality for Verona.

Finally, regarding the shared management of common goods and the use of renewable energies, the Lupi di Toscana barracks proposes innovative solutions, such as urban gardens, and community participation in the management of cultural and service spaces. Both projects foresee the installation of photovoltaic panels and the implementation of energy efficiency standards in the new buildings, which will contribute to improving the sustainability of these interventions. However, in the case of Santa Caterina, less information is available on community participation in managing the spaces.

VI. DISCUSSION

The compilation of the results allows a discussion based on various aspects, revealing four key factors that have contributed to determining the new uses.

The first consideration is whether it is possible to regard the prolonged abandonment as an “agent” that has contributed to the ruin of almost all the buildings built, implying a radical morphological change of the barracks between the current state and the project. In the field of architectural-urban studies, authors such as Turri (2014) have highlighted the importance of old barracks as heritage, regardless of their age. In general, it is recognized that these places are significant components of the built environment due to their architectural, engineering, technological, urban, and symbolic qualities, which can offer numerous opportunities for conversion with civil society. However, the barracks, built in the 1940s and 1950s according to a functionalist model, have suffered a prolonged period of underutilization and abandonment, resulting in severe deterioration of both the open and built spaces, as demonstrated by Cacciaguerra and Gatti (2009).

The second and third key factors triggering the conversion were, respectively, the transfer of ownership of the barracks through the *federal demaniale* mechanism and the state public funding granted in 2021. The

¹³ <https://www.immobiliare.it/mercato-immobiliare/toscana/firenze/legnaia-soffiano/>

¹⁴ <https://www.immobiliare.it/mercato-immobiliare/veneto/verona/borgo-venezia-santa-croce/>

¹⁵ <https://www.immobiliare.it/mercato-immobiliare/veneto/verona/>

particularity of the Italian context, as far as this type of vacuum is concerned, contributed to blocking the operations. In fact, the continuous change of decisions of the Ministry of Defense on the management of its properties implied its underutilization for a decade, to end up in its definitive abandonment that coincides with a context of acute crisis of the real estate sector, which is why the same Ministry has not been able to achieve the sale of these assets through public auctions. Given this impossibility, both assets were transferred free of charge to the respective local administrations that began to consider their conversion.

Finally, there is the integrated approach of the projects. The conversion of military lands located in peripheral areas of cities requires comprehensive urban-scale planning based on a medium- or long-term future development scenario. In fact, the analysis demonstrates the implementation of this approach and highlights that the old barracks can contribute to defining more inclusive, safe, resilient, and sustainable urban environments. However, several issues remain to be defined in greater detail, among which energy efficiency and the guarantee of the right to the city, through the allocation of truly accessible housing to the population with fewer resources, stand out. When comparing the average rental and sale prices of the city and the area where the old barracks are located, the case studies are more affordable. Faced with this situation, municipal administrations have the possibility of offering a solution based on surveys dedicated to finding out the reality of housing demand at the urban level to meet the needs of the weakest segment of the population, who, although they do not fall within the parameters for accessing social housing, need access to the market.

VII. CONCLUSIONS

The research carried out is a first step towards gaining a deeper understanding of the urban regeneration actions implemented in the peripheries of Italian cities. The work also provides a first attempt to categorize these projects.

This study demonstrates how the qualitative evaluation of 10 relevant elements, in terms of urban regeneration and sustainable development, leads to a deeper understanding of the characteristics of the conversion processes of former military barracks. This assessment can be applied to other types of abandoned areas in other national contexts, regardless of the original use. The evaluation allows for a more detailed assessment of the capacity that the new uses can have, as well as the process that sustains them, to achieve greater sustainability of the intervention and ensure a better integration of this old military piece into its context. In the case of the Lupi di Toscana barracks, the higher score (15/20) shows that the process is better directed towards a more sustainable urban development than the Santa

Caterina barracks (9/20), which does not sufficiently address fundamental issues for urban regeneration, such as social aspects and public participation.

It is recognized that comparative research between two cities is complex and has numerous aspects that require further review, such as the condensation of a large amount of information and the selection of a few bibliographic references for each case study. It is also true that the qualitative interpretation of large urban projects that have not yet been carried out reduces the relevance of their evaluation. Even so, this research is considered an important step towards developing a comparative analytical framework for evaluating the conversion processes of military facilities, applicable to other urban empty types, particularly those characterized by inclusive, green, and good governance cities. In addition, this study provides the possibility of applying this framework in other geographical contexts, such as Latin America, where barracks also occupy strategic and socially sensitive spaces.

VIII. CONTRIBUTION OF AUTHORS CRediT:

Conceptualization, F.C.; Data curation, R.C.H.; Formal analysis, F.C.; Acquisition of financing, R.C.H.; Research, F.C. and R.C.H.; Methodology, F.C. and R.C.H.; Project Management, F.C.; Resources, R.C.H.; Software, R.C.H.; Supervision, F.C.; Validation, R.C.H.; Visualization, F.C.; Writing - Original draft, F.C. and R.C.H.; Writing - proofreading and editing, F.C. and R.C.H.

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