

Article

Industrial Heritage in Malaga (Spain): Research and Education via Four Key Design Concepts

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Abstract: The industrial heritage in Spain, despite important advancements in the past decades, remains under-recognized, vulnerable, and inadequately appreciated. Its potential for contributing to local resilience and sustainability in the face of deindustrialization challenges is one of the best assets it has. This paper highlights the analysis of two case studies focused on the restoration of industrial heritage sites, namely the Sugar Mill “El Tarajal” in Malaga and the Trapiche del Prado in Marbella, conducted in collaboration between the University G. d’Annunzio of Chieti and Pescara and the University of Malaga. Four key concepts are identified: historical analysis and its impact on industrial evolution, production system transformations and their influence on buildings, the relationship between industry and its surroundings, and the impact of rehabilitation on the urban context. The recovery of industrial heritage goes beyond architectural preservation, emphasizing the importance of adapting these spaces for contemporary purposes and integrating modern technologies and sustainability approaches to drive socioeconomic revitalization. To address the vulnerabilities and lack of recognition faced by industrial heritage, a connection between research and education is discussed to disseminate knowledge among students and professionals in training. This approach aims to provide a more comprehensive and informed restoration process that considers the territorial scale, thereby translating assessment indicators into the design and preservation of industrial heritage sites.



Citation: Cimadomo, G.; Varagnoli, C. Industrial Heritage in Malaga (Spain): Research and Education via Four Key Design Concepts. *Heritage* **2023**, *6*, 7624–7639. <https://doi.org/10.3390/heritage6120401>

Academic Editor: Craig J. Kennedy

Received: 17 October 2023

Revised: 30 November 2023

Accepted: 7 December 2023

Published: 10 December 2023



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Keywords: industrial heritage; adaptive reuse; heritage revitalization; restoration; Malaga; sugar mill

1. Introduction

The recognition and inclusion of industrial heritage among cultural assets and the lists created to protect them vary depending on the specific cultural heritage conservation policies of each country. In general, industrial heritage began to be valued and included in heritage lists in recent decades of the 20th and the early 21st century. In Spain, one of the most significant milestones in the protection of industrial heritage was the approval of Law 16/1985, of 25 June, on Spanish Historical Heritage. This law established a legal framework for the protection, preservation, and dissemination of cultural heritage, including industrial heritage. However, it was not until the approval of the National Plan for Industrial Heritage in 2001, promoted by the Ministry of Culture and with the participation of autonomous communities and various experts, that Spanish industrial heritage began to gain visibility, and a greater number of buildings and complexes started receiving the necessary attention for their conservation and protection. The first revision of this plan [1] encompasses various categories, including isolated structures, complexes, industrial landscapes, as well as machinery and intangible industrial heritage, illustrating the variety and complexity that industrial activity has generated over time. Despite the growing attention this discipline has received and several best practices developed since the 1980s, industrial heritage in Spain remains an emerging legacy that still faces high vulnerability and has not yet

received the recognition and appreciation it deserves [2]. Many episodes of industrialization have disappeared, been partially conserved with questionable criteria, or are in a state of abandonment that jeopardizes their preservation and appreciation despite their historical and cultural significance. This trend calls for increased efforts to protect and promote these industrial sites as an integral part of our collective heritage.

These efforts involve recognizing industrial heritage as a valuable resource for territorial development, sustainability, and resilience, aspects that are relatively recent in Spain compared to other European countries with a history of industrialization where the conservation and reuse of industrial sites are more established. Thus, their role in promoting new uses that add value to the territory and promote socioeconomic revitalization is acknowledged [3]. At the same time, it is essential to emphasize the need to move beyond an approach solely based on historical documentation, highlighting the importance of considering strategies that integrate globalization processes and territorial dynamics. This is particularly important given the special complexity and heterogeneity of the elements encompassed in this category.

There is a growing recognition of the need to adopt an approach that is attentive to characterizing industrial heritage elements and their transformation into productive resources, contributing to local resilience and sustainability in the face of the challenges of deindustrialization. The study of industrial heritage cannot be carried out without a comprehensive view of the territory in which it is situated, a landscape anthropized by industrial activity resulting from the needs of industrial processes, the transportation of raw materials, as well as finished or semi-finished products. These landscapes are testimonies to the everyday life and the culture of a community, serving as repositories of collective memory. At the same time, they are highly ephemeral due to the transformations of industrial processes and the obsolescence that has led to the abandonment and forgetfulness of many activities [4,5]. Lastly, it is essential to keep human beings in the equation, as their physical presence and the modifications they make also breathe life into the landscape. Humans can only navigate and understand natural elements via their culture, which allows them to identify landmarks in the landscape. The study and intervention of these landmarks are only possible within their own territorial context and not in isolation, especially when industry is a direct consequence of human action on the natural environment [6].

The role of the new function, advocated by the restorer Gustavo Giovannoni as early as the 20th century, provides a theoretical framework through which many industrial buildings can be repurposed to regain their former glory. However, it is still often misunderstood by many professionals because simply preserving the most valuable elements of the building or its envelope is not sufficient to maintain the cultural value that these buildings possess [7]. International organizations such as UNESCO, ICOMOS, and TICCIH have advocated and developed methodologies and best practices for the valorization of cultural heritage in general, including industrial heritage. The recent literature directs its research toward the definition of Multi-criteria Decision Making by which to make the most appropriate decisions or to assess the effectiveness of interventions carried out [8]. The proposed models are often based on criteria that vary in their comprehensiveness, objectivity in compilation, and complexity in resolving through specific methodologies, such as the Fuzzy Delphi Method, among others, to reach a consensus among experts and formulate appropriate recommendations [7,9,10]. The models, and by extension, meta-models that attempt to provide an abstraction for more general application [11], clearly have the limitation of not being universal. The necessary abstraction to enable their agile application contrasts with the impossibility of finding a homogeneity of methods in architectural intervention for the preservation and revitalization of heritage.

Once the most prominent criteria for evaluating an industrial heritage intervention project are established, the next step is to put them into practice in the corresponding architectural projects necessary for their execution. Architecture is a creative field where the uniqueness of each intervention is evident. The difficulty in establishing a standard methodology for the realization of any architectural project lies in the diversity of constraints and

contexts that characterize each commission. Every single project presents unique challenges that require specific approaches, from site constraints to client preferences. Furthermore, it is not possible to generalize the process, as each architect has their own style, approach, and design philosophy, adding another layer of complexity. Finally, architecture is an art that thrives on individuality and creativity, making the methodology a highly personalized and adaptable process tailored to the circumstances of each project [12].

To advance the improvement in tangible industrial heritage intervention processes, an analysis is conducted on two Master's thesis projects carried out at the "Laboratorio di Restauro" of the University G. d'Annunzio of Chieti and Pescara in collaboration with the University of Malaga. The collaboration is the continuation of shared research started under the support of Erasmus+ mobility programs. The didactic experiment undertaken sought to combine the approach attentive to the inclusion of new functions and social and political spillover, more frequent in Spain [13,14], with the approach related to the understanding of the architectural object in all its aspects, recurring in Italy [15,16]. This made it possible to recognize historical and aesthetic values in the two analyzed works and to start from this recognition to arrive at a project capable of integrating innovative aspects and preservation of the buildings' fundamental features in line with the most recent developments in the discipline [17–19]. The aim remains to defend a historical testimony of industrial development in Andalusia but also defending the resulting landscape, thus attempting to indicate alternative developments to pure speculative building expansion. The research therefore foresees the interchange of teaching strategies between two different realities, focusing more on the methods than on the results. Four concepts of utmost relevance for the understanding and protection of these buildings are identified and discussed: (1) the implementation of aspects related to historical analysis and their impact on the evolution of industrial activities, (2) the transformations of production systems and their impact on the building, (3) the territorial scale and the impact of industry on its surroundings, and finally, (4) the impact of the rehabilitation project on the urban context.

2. Case Studies

The existing Erasmus agreement between the Facoltà di Architettura of the University G. d'Annunzio of Chieti-Pescara and the Higher Technical School of Architecture of the University of Malaga has allowed, in addition to ongoing student exchanges, the completion of two Master's thesis projects on industrial buildings in the province of Malaga in the framework of the "Laboratorio di Restauro". This international experience has enabled the comparison of different teaching methodologies, enriching students both personally and professionally. Equally important, it offers an opportunity to reflect on the relationship between teaching and research in the field of industrial architectural heritage restoration in the identification and development of methodologies that facilitate the preservation of this valuable legacy in an agile manner, free from the pressures that could limit a real-world experience subject to economic demands and requirements. In fact, being able to design a program without external constraints, aligned with the analysis of the building and its context (geographical and social), adds significant value to these projects since not every function is suitable for every building [20].

The Master's thesis projects completed under this agreement at the "Laboratorio di Restauro" of the University G. d'Annunzio in Chieti and Pescara were the rehabilitation of the former Sugar Mill "El Tarajal" in Malaga [21] and the rehabilitation of the Trapiche del Prado in Marbella [22]. The *Azucarera Malagueña "El Tarajal"* is an old sugar mill later converted into a cork factory. It is currently abandoned and in an advanced state of deterioration in an area of great interest for the urban development of the city of Malaga. During the project's development period, the city of Malaga was in the early stages of preparing the bid for hosting a World Expo in 2027 in a close area.

The second project involves the Trapiche del Prado, another sugar mill located on the outskirts of Marbella. This building, constructed in the 17th century on the slopes of the Sierra Blanca mountains, has changed functions several times and is currently in a state of

abandonment. During the project's development, the municipality was defining a building consolidation intervention, which will ultimately house a senior residence.

Although the design process attempts to remain independent of tangible dynamics that may be ongoing during the exercises, buildings are selected for their great relevance for the future of the cities in the province of Malaga. In both cases, the design methodology is common, involving historical analysis of the buildings and their evolution over time in relation to their functions and activities, construction typologies, as well as on-site analysis of materials and the dimensions of their elements. Common objectives include introducing new functions while considering the realities of the territories and the value of the landscapes, as well as preserving the integrity of two important historical testimonies. In both cases, the architectural intervention also utilized contemporary languages and technologies but with the aim of preserving the authenticity of the building. The new function assigned to the buildings is the result of careful analysis of the urban and social context in which the buildings are located, and it ultimately is the decision of each student.

2.1. Sugar Mill "El Tarajal", Malaga (Spain)

El Tarajal sugar mill, a joint-stock company with representatives from Malaga's high society familiar with politics and business, is a significant example of steam sugar production in Malaga. The company was established in 1930 and began operating in 1931, when the factory's construction was completed on land near the Guadalhorce River, and authorization for production was obtained. Despite ambitions to be the first of a series of factories in the province, and while it was initially planned to process sugar cane and beets to avoid the seasonality of traditional cultivation, it operated for only a few years before being dismantled in 1939. Subsequently, from 1945, it was used as a cork stopper factory until the 1960s, after which the building began a process of abandonment and progressive deterioration [23]. Designed by architect Manuel Rivera Vera (1879–1940), the factory is a prominent example of the Malaga industry in the first half of the 20th century. It features exposed brick, lowered arches, pediments on the entrance pavilions, and ornamental finishes on the corners. The load-bearing masonry structure and metal trusses supporting lightweight roofs allowed for spacious, open-plan, and high-ceiling spaces. The building has Grade II architectural protection in the current Malaga planning, with the chimney subject to the highest protection. The industrial installation included various auxiliary buildings, from housing for workers and engineers in charge of the factory to warehouses, all of which have been demolished. Only the main irregularly shaped H-building, the chimney, and an interesting water tank remain (Figure 1). Due to the abandonment of industrial activity, the level of deterioration is high, and all traces of machinery have also disappeared [23].

The Master's thesis project envisions a scattered museum that establishes a connection between the cultural and environmental assets in the study area and the influence of the factory. This includes the significant archaeological remains in the area, the Bacardi estate, the aqueduct of the "Fuente del Rey", as well as the riverside natural park along the Guadalhorce River. The most emblematic element of this intermediate-scale project would be the conversion of the main building of the sugar mill into a museum and interpretation center for the Malaga industry. The decision is taken due to the consideration that most of the industrial heritage (tangible and intangible) in the city of Malaga has disappeared (only partial elements like chimneys have been protected), being el Tarajal factory a heritage element of great value to transmit the industrial past of the city. It would also serve as a support for the nearby Teatinos University campus and the Technology Park of Andalusia (PTA). This involves the inclusion of laboratories, a business incubator, and several spaces for presentations and conferences. This multiplicity of uses allows for the development of the city by establishing a new focal point, which can help alleviate pressures on the more central areas of the city while also creating a green itinerary and promoting the values of heritage and nature.



Figure 1. El Tarajal Sugar Mill, Malaga (Spain). Source: Federica Dragani, 2020.

2.2. *El Trapiche del Prado, Marbella (Spain)*

The history of the building known as the Trapiche del Prado in the touristic town of Marbella, Malaga, dates back to 1644 when the city authorities granted permission to two Flemish partners to build a factory for the processing of sugarcane. The activity was seized by the Royal Treasury due to an unpaid debt in 1688, and it was then passed to the Granada Inquisition. From the early 18th century, it changed hands among various entrepreneurs. Despite significant reforms in the 1760s, soon after, the Trapiche was in decline. In 1800, Enrique Grivegnée became the new owner and introduced innovative technologies related to the industrial process. However, despite his efforts, the sugarcane industry faced challenges that made its transformation unprofitable.

At the beginning of the 20th century, it changed its productive activity, adapting the facilities to the production of muscatel wine and liqueurs. Throughout its history, the Trapiche del Prado has witnessed the rise and decline in the sugarcane industry in the region, and the challenges that the Malaga industry has faced during its periods of industrialization [24].

The building is composed of a series of compact pavilions that create an irregular shape (Figure 2). The volumes are defined by their function in the production process and the needs that arose over time, making it difficult to establish a chronological order for the entire complex. The irregular topography of the plot is utilized in the configuration of the building, which extends up to three levels in the south orientation. Built with load-bearing brick, wooden trusses, and Arab-style tile roofs, the most interesting elements, although challenging to date, are the south entrance portico and the portico on the north facade. The first features two pointed arches preceded by a wide staircase, and the second has two semicircular arches and a lowered central arch, a rhythm that is repeated on the first floor, with the central opening replaced by a window, the dating of which is uncertain. A circular structure near the east facade was used for peeling and chopping the sugarcane before grinding. The ruins of the pavilion suggest a two-level structure, which is unique for the time period. The main source of energy came from the aqueduct that passes by the west facade, for which privileges of use have been documented since 1644.

The Master's thesis project envisions the creation of a multipurpose sports center with activities both indoors (fitness, gym, and climbing) and outdoors (tennis, swimming, and leisure). The program has been defined after the analysis of the neighborhood, which shows an extremely dense housing development, a lack of public facilities, and gathering spaces complicated by the rough topography. The sports center will offer the opportunity

to revitalize the area, creating continued use of the public and private spaces during most part of the day. The analysis of the industrial production process is incorporated to give meaning to the new programmed functions. This involves proposing new volumes to replace the more degraded and lower-quality constructed spaces, such as the stables or the previously mentioned “palacio de la batalla”, where peeling took place. Only the start of its wall remains from the latter. The existing slope and the analysis of the proximity area are used to suggest the definition of a terraced system for the use of outdoor spaces around the building, independent of the sports activities. Additionally, semi-underground parking spaces are proposed.



Figure 2. El Trapiche del Prado, Marbella (Spain). Source: Guido Cimadomo, 2022.

3. Discussion

Addressing the challenges posed by the study, assessment, and intervention of industrial complexes as a resource, historical-cultural testimony, and an increasingly important environmental factor for the quality of life of citizens are key aspects of interventions in industrial architectural heritage [25]. The two Master's thesis projects developed within the framework of the “Laboratorio di Restauro” focus on two buildings of great historical importance and the potential impact their scale can have on the territory. Their state of abandonment and advanced deterioration demonstrate the need to address the intervention with multi-scalar criteria, highlighting their potential value that is not taken into account by public and private actors. Both buildings transcend the local scale of single-building intervention, affecting a much larger area with far-reaching implications in any urban setting.

The Tarajal factory holds significant landscape relevance, characterized by the Guadalhorce River Park and archaeological remains dating back to Roman times. These factors have allowed this industrial installation to remain isolated in the territory, free from the pressures of large building complexes in its vicinity, also aided by the presence of the railway and the road to Cartama. This situation enhances its symbolic landscape value. In contrast to the previous case study, the Trapiche del Prado is located in an environment with high building pressures that have surrounded the industrial site despite the significant slope that marks the beginning of the Sierra Blanca mountains. The added value of preserving this complex lies in its relationship with the built environment, providing an opportunity to generate spatial and architectural value and offering services to the nearby community on a more urban scale. These two projects are used to analyze four scales that are considered essential for studying industrial heritage from a comprehensive perspective, including the impact of industrial heritage on the development of contemporary society and its technological evolution on a larger scale. This involves considering industrial

heritage sites and artifacts from a broader perspective than just the building or its ruins, taking into account their historical, cultural, and social significance:

- Historical analysis and impact on the evolution of industrial activities;
- Transformations in production systems and their impact on the building and its evolution;
- Territorial scale and the impact of industry on its surroundings;
- The sensitivity of the rehabilitation project and its impact on the urban context.

3.1. Historical Analysis and Impact on the Evolution of Industrial Activities

Historical analysis and documentation of the evolution and transformation of both the industrial process and the building where it takes place are closely related and are undoubtedly the first step for any intervention in built heritage. The timeframe of industrial buildings is shorter than that of other heritage categories, with the early 19th century, the period of the first industrial revolution, being the peak of industrial growth in the region. While there are numerous older buildings—the Trapiche del Prado dates back to the 16th century—there is a significant number of buildings with a shorter history, which does not necessarily translate to easier documentation. Since these buildings have not received protection or interest from the public and authorities, the records for their documentation are often scarce and scattered across multiple archives. The shorter lifespan has not limited the transformations of both the activities and the buildings that housed them since they were dynamic activities linked to demand and supply, subject to changes driven by innovations that improved industrial, chemical, and mechanical processes related to production and transformation, to make them more competitive. Therefore, comprehensive documentation of the history of industrial activity is necessary, allowing an understanding of the evolution and transformation of buildings and places designated for industrial production. Understanding the production systems and the processes required for industrial activity, as well as the spaces required for each of them, is also relevant, as will be seen in the following point, to maintain the identity of the activity throughout the intervention process.

This analysis enables decision-making for the future of the industrial complex, allowing decisions related to the preservation, transformation, or demolition of built elements of greater or lesser value, depending on design and functional criteria.

In the restoration project of the Tarajal Sugar Factory, several complementary buildings to the sugar mill were recognized, such as worker housing and the director's residence, which were later demolished between 2007 and 2016 after the closure of all industrial activities (Figure 3). During the cork transformation activity, the factory was expanded with a new building attached to the southernmost part to meet the production needs of the new activity and for packaging before the distribution of finished products. This building also disappeared during the aforementioned period. The analysis suggests not reconstructing these elements, as they are considered secondary and would not contribute to a clear interpretation of the industrial building once it is repurposed for its new function.

In the Trapiche del Prado, the decision was made to demolish some volumes with limited architectural value and a high degree of deterioration, which were used as stables, in order to create new spaces more suitable for current needs intended for sports activities (Figure 4).

In some cases, it is possible to reverse the process via a careful analysis of the architectural remains, construction systems, and building materials used. This allows for the dating of pavilions in an industrial complex and can help understand the historical evolution of the activities within it, as well as the needs and transformations that have occurred. The complexity of this analysis depends on the size of the industrial complex being studied and the ownership of the property. Both case studies dealt with large, ruined complexes with severe access restrictions. In the case of the Trapiche, a drone was used for digital documentation (structure to motion) to create a three-dimensional reconstruction from a series of two-dimensional photographs, facilitating this phase of the study. In the case of the Azucarera del Tarajal, traditional methods were used, making it possible to identify the extension of a warehouse—later demolished—around 1949–50 to increase the

production of cork, which had replaced the original activity in 1946. Similarly, a detailed analysis of the building, combined with historical photographic documentation, allowed the reconstruction of the existing mezzanine galleries in many of the industrial pavilions, which have now largely disappeared.

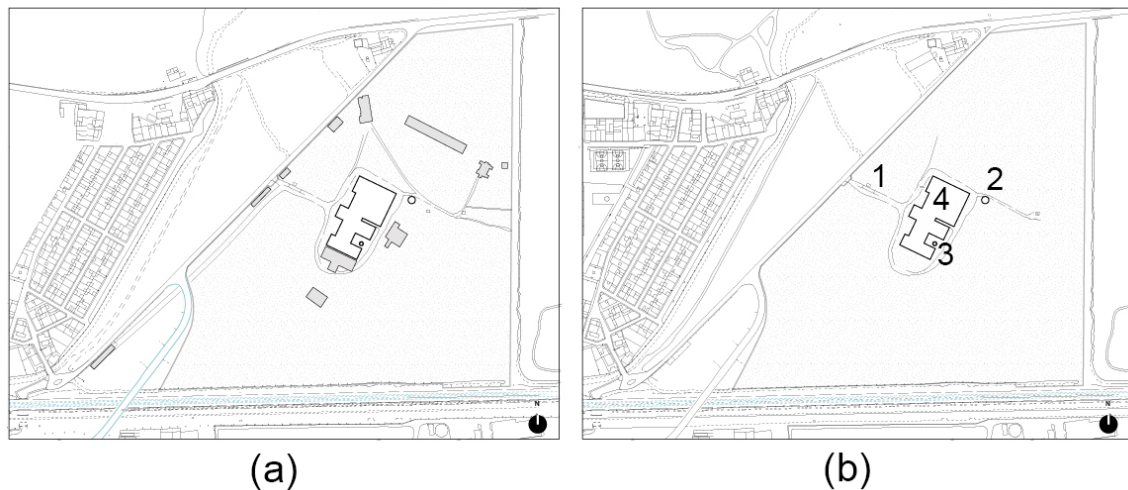


Figure 3. Identification of the different phases of the El Tarajal industrial complex. (a) Light grey: demolitions between 2007 and 2016; light blue: new bridge over the railways 1990. (b) Present state: 1. control gate; 2. water tower; 3. chimney; 4. main building. Source: Federica Dragani, 2020.

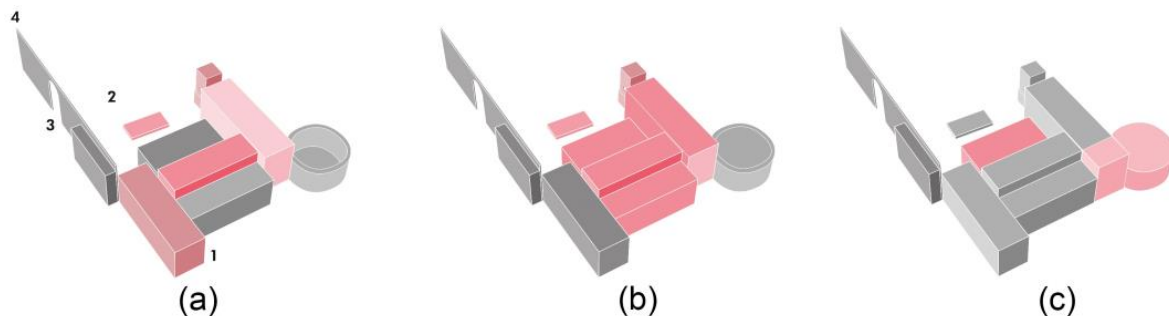


Figure 4. Identification of design strategies, the Trapiche del Prado. (a) Circulation flows: 1. south entrance; 2. north entrance; 3. northwest public access; 4. aqueduct. (b) Activities: dark grey. management and leisure; pink. sport; light grey. wellness. (c) Design strategies: light grey. restoration of existing volumes; pink. reconstruction of damaged volumes. Source: Vincenzo Stapane, 2022.

3.2. Transformations in Production Systems and Their Impact on the Building and Its Evolution

The importance of documenting industrial processes and activities during the historical analysis and documentation phase has been mentioned. This not only helps understand the historical evolution of the industrial complex and its transformations but also serves as a design tool to preserve cultural identity and historical memory even when the industrial machinery has disappeared and changes in use are considered. While each project is developed independently in relation to its context, it is essential to maintain the essential pre-existing values. The historical memory of labor, although indirectly accessible as in the cases presented, contributes to maintaining a relationship with the local population and leaves a lasting memory of local industries [26,27]. The change in use, once the trend of transforming any historical building into a museum has been exhausted, brings criticism about the emptying of the original content. A project that aims to enhance cultural heritage, in this case, industrial heritage, must allow for the interpretation of the original values, whether related to the architectural space or the production that took place there [26].

The project for the Tarajal Sugar Mill proposes a range of complementary uses, including a space dedicated to the presentation and interpretation of industrial machines, even though the building has been stripped of all industrial remnants. Once the product routes, from the storage of raw materials to the distribution of the finished product and the processes that made it possible, have been reconstructed (Figure 5), the idea is to recover the logic used during the cork production era. The main hall, which was once an area for processing, will serve as a museum space with a lineup of machinery that recalls the original production line. This machinery will also be observed from the reconstructed perimeter gallery. Similarly, the charcoal kiln, which allowed energy generation via the nearby boiler, will be transformed into an “air factory”, a botanical filtration system for indoor air purification [28]. The system, previously tested at the Florence Tobacco Factory, not only reduces the building’s energy demand, but it also architecturally and philologically reinterprets the coal storage space as a source of energy for the building’s operation.

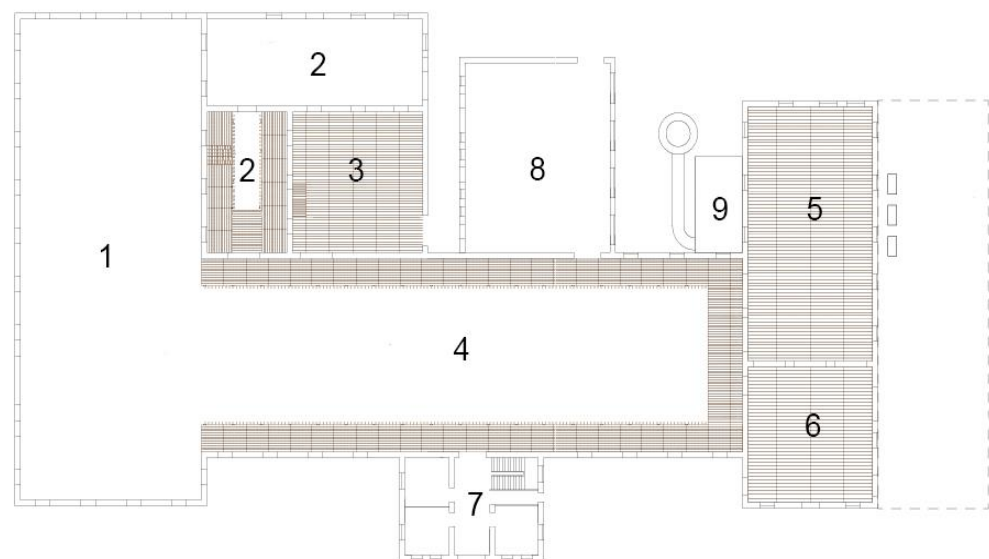


Figure 5. Activities and intended use of spaces, Tarajal Factory. 1. raw material storage; 2. early transformations; 3. warehouse; 4. production area; 5. immersion basins; 6. cork press; 7. offices; 8. charcoal kiln; 9. boiler. Source: Federica Dragani, 2020.

In the case of the Trapiche del Prado, the identification of the names by which the factory spaces were known (such as “el palacio de la batalla”, where peeling was carried out; “la molienda”, where both animal and hydraulic mills were used; “la cocina” or boiler room, where the previously obtained broth was boiled; and lastly, “los asoladeros”, where the sugar placed in molds was left to dry) allows for a reinterpretation of these spaces adapted to the proposed new program. For example, the cardio and weightlifting gym is located in the former “molienda” due to the similarity in the physical effort generated in that space. “Los asoladeros” houses an indoor climbing wall, reminiscent of the fact that the molds were placed at a certain height to take advantage of the warmer environment, which may be rediscovered by contemporary climbers. “El palacio de la batalla”, of which only its footprint remains, is reconstructed to house a spa, seeking a tenuous connection with the tank where the cleaned sugar was deposited before the industrial process began. While it was not possible to recover a proposal linked to the original flows in this project, these design decisions bring the old industrial use closer to the new sports activities, carefully explained to users via informational panels.

3.3. Territorial Scale and the Impact of Industry on Its Environment

The change in scale in the interpretation and preservation of cultural heritage, from that of the individual element to the territorial scale, has become more pronounced in recent decades, making any action aimed at the conservation of heritage assets more complex. In

the field of industrial heritage, this trend is particularly significant, as any industrial activity is logically linked to the arrival of raw materials and the efficient distribution of manufactured products, which are necessarily related to the territorial scale. These aspects are of great importance when deciding the location of an industry that has historically sought proximity to ports or railway lines for distribution reasons or closeness to the raw materials to optimize production processes. The former protection of elements considered of artistic or cultural interest detached from any context allowing for their comprehension has been superseded by the need to consider the landscape and, therefore, a broader territorial scale for the correct interpretation of the identity and value of the studied complex.

The territorial context offers the possibility of creating a link with the community, which is considered essential for maintaining the identity and memory of the industry. A broader context for the interpretation of the assets to be rehabilitated also provides the opportunity for the community, via networks and associations established in the territory, to participate in their management, which can be a valuable economic resource if properly approached [2]. Both the European Landscape Convention promoted by the Council of Europe and the Recommendation on Historic Urban Landscapes by UNESCO, published during the first decade of this century, encourage a different perspective on the landscape, endowing it with values and meanings not previously considered [29]. The specificity of industrial landscapes, their high level of human impact, and the dynamics they generate nonetheless require specific methodologies for their valorization [25].

The two selected industries have a scale that surpasses that of isolated buildings. Both represent a set of different volumes required for all production phases, and they are located on the outskirts of urban centers, possibly a reason why they have not disappeared due to the pressures of real estate growth. The Azucarera del Tarajal, located near the Antequera-Málaga railway line, is analyzed as a place that could be transformed into a new centrality in the city. The project includes a series of strategic connections to the city center, which would benefit from alleviating some of the density that accumulates there, as well as to the Teatinos University campus and the Technology Park of Andalusia, which would find in the new building a meeting place and a hub for knowledge transfer. The green path along the Guadalhorce River is also integrated into the project, creating a cultural route that connects different heritage elements scattered across the territory while reestablishing the historical relationship between the city and the water (Figure 6).

The urban pressure in the coastal municipality of Marbella has gradually occupied the hillsides with residential buildings, ultimately surrounding the Trapiche factory. Only the spacious 12,000 sq.m. plot on which the factory is located has allowed the preservation of the building (despite the decay due to disuse and lack of maintenance) and also enables its interpretation in relation to the surroundings. The current colonization policies are based on constructing the maximum number of residential units allowed by the existing urban planning, minimizing infrastructure and services. This project has a different approach than the previous proposal, as it focuses on services for the neighborhood, offering different levels of use. While private management is considered for the sports facilities inside the building, there are also public sports and recreational facilities planned for the rest of the plot. Tennis, football, and basketball courts open to the neighbors aim to activate this site during extended hours, revitalizing the area. The planned green spaces also offer meeting places for the residents, providing an important tool for urban regeneration (Figure 7).

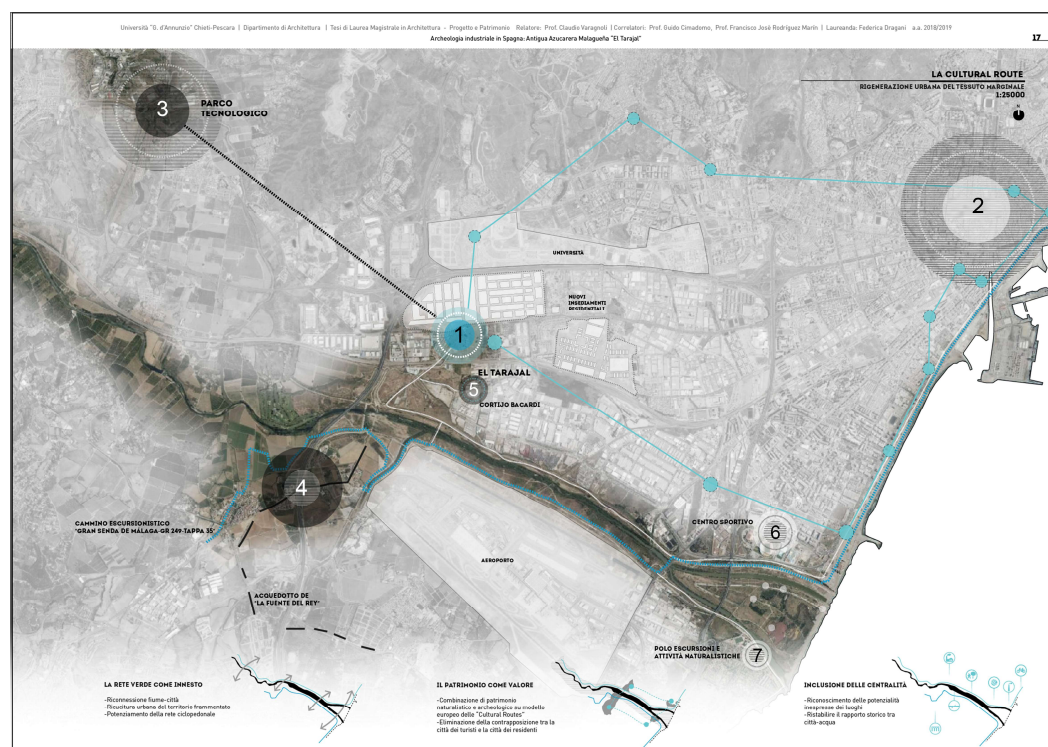
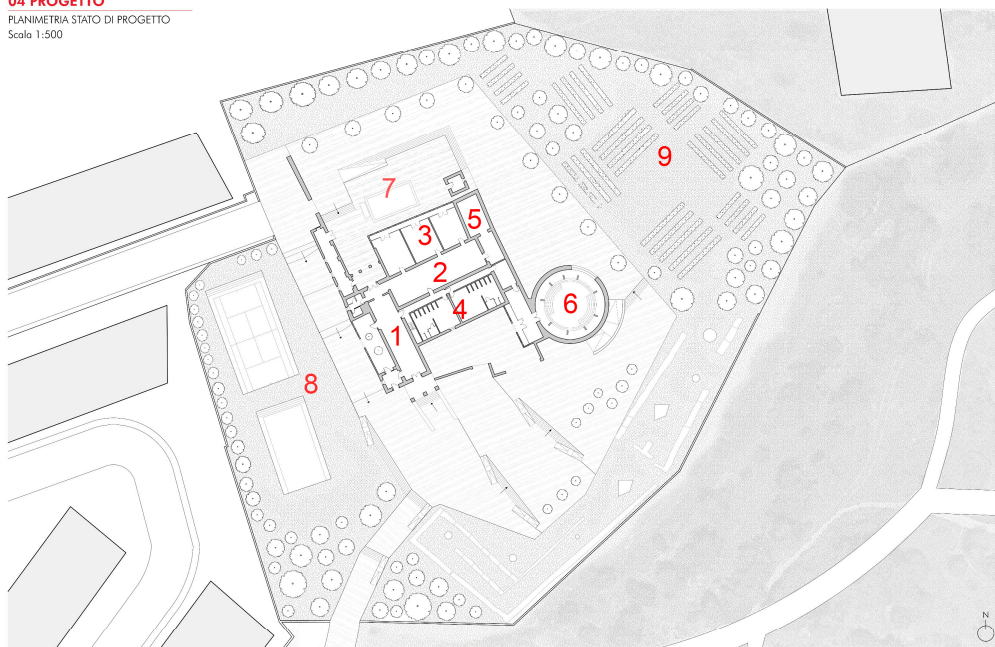


Figure 6. Centralities and new connections of the Tarajal factory. 1. Tarajal factory; 2. downtown Malaga; 3. Andalusian Technological Park (PTA); 4. naturalistic walkway; 5. Bacardi factory; 6. local sports facilities; 7. naturalistic activities. Source: Federica Dragani, 2020.

04 PROGETTO

PLANIMETRIA STATO DI PROGETTO
Scala 1:500



Patrimonio industriale in Spagna: progetti per la conservazione
della azucarera Trapique del Prado di Marbella

Figure 7. Design strategies for the revitalization of the urban environment, Trapique del Prado. Private spaces (1–7): 1. foyer; 2. cardio activities; 3. fitness rooms; 4. locker rooms; 5. indoor climbing; 6. spa; 7. outdoor swimming pool; public spaces (8, 9): 8. sports facilities; 9. green spaces. Source: Vincenzo Stapane, 2022.

3.4. Sensitivity of the Rehabilitation Project and Its Impact on the Urban Context

The recovery of industrial heritage provides an opportunity to revitalize urban environments in a sustainable manner, generating new dynamics and opportunities via user experiences and holistic processes that include the renovation of physical structures, the preservation of cultural heritage, and the promotion of sustainable urban regeneration [30]. The rehabilitation of industrial environments therefore requires careful planning to introduce elements that, in addition to promoting the industrial heritage of the past and providing new functionalities demanded by their urban surroundings, impact this third pillar of sustainable urban transformations. Martinovic and Ifko [31] investigated, albeit limited to the post-war context, how industrial heritage sites in danger due to their social, historical, architectural, and technological values provide a fruitful basis for incorporating sustainability principles and how they can be considered a catalyst for urban regeneration. Sustainability and the circular economy are among the most relevant aspects sought when intervening in historic buildings and are often the main reason to reuse instead of rebuilding existing facilities [32]. However, urban reactivation policies and local development have been the main relevant aspects fostered by these proposals, as in many other case studies [33]. Industrial heritage is, in fact, a resource for revitalizing territories, improving landscapes, and cultivating identities when a social construction of the concept, also based on heritage education, is developed [1,5]. In this section, opportunities to link the identity and history of recovered industrial buildings to the environment in which they are located, especially with their population, are considered, while in the previous section, relationships with the existing economic and social fabric of the city are analyzed and promoted at a scale that exceeds that of the building itself, in this section, the opportunities that can be developed at different levels within the place under study are considered.

The project for the Azucarera del Tarajal takes advantage of the existence of remains from Roman and Islamic times, even creating an archaeological park that connects classical archaeology with industrial archaeology in the northern part of the plot. The creation of a park that offers a starting or ending point for pedestrian and cycling routes linked to a cultural route along the Guadalhorce River bank offers various opportunities for enjoying the area, such as leisure and cultural activities, the presence of a botanical garden, and even sports activities. The goal is to create a new centrality that can attract nearby citizens, even if they are not directly related to the activities taking place inside the building (museum, research, and teaching). In the Trapiche del Prado project, a similar strategy is considered, introducing outdoor sports facilities that can be used by local residents independently of the activities of the sports center and during extended hours. These strategies allow for the occupation of the surroundings of the recovered industrial buildings, revitalizing their environment, providing services and leisure opportunities for the population, and attempting to generate a sense of belonging and identity for the community. The opportunities for using ex-industrial spaces throughout the day offer urban revitalization opportunities along with the optimization of available resources.

4. Conclusions

The recovery and preservation of industrial heritage represent a multidimensional challenge involving historical, cultural, urban, and social aspects. Over the past few decades, the recognition and appreciation of industrial heritage have evolved, finding a place on the agenda for the conservation and revitalization of cities. While this process has advanced, there are still challenges in protecting and promoting these sites that have been fundamental to the historical and cultural development of communities. The significant differences in characterizing industrial heritage, including categories like standalone structures, complexes, and industrial landscapes, as well as machinery and intangible industrial heritage, show the variety and complexity required for any rehabilitation and valorization effort. The recovery of industrial heritage goes beyond architectural conservation, which is the most important lesson for the students involved in their Master's thesis projects. Students face the challenge of understanding the historical transformations of industrial

activities and their impact on buildings and the surrounding territory. The historical study of these buildings, along with their business transformations, expectations, and achievements, has allowed us to understand the dynamics of these companies, which were always attentive to changes in customs policies, the emergence of pests and crop reduction, and the innovation of technologies and machinery. The production of sugar in Malaga had consequences on the agricultural activity of the eastern province, as more sugar cane was needed in the process [34]. These factors provided opportunities for local and international entrepreneurs, enabling Malaga to become the second most industrialized province in Spain in the second half of the 19th century. This industrial boom was the origin of a substantial urban transformation, until its decline and replacement by other economic drivers, primarily tourism, which has erased almost all traces related to this industrial past [35]. Recognizing the value of these buildings and their activities in maintaining the common cultural identity that has characterized the province has led students to have a strong intention to use adaptive restoration criteria so that these factories can once again become key locations in the contemporary life of the cities, albeit with different strategies, described in this article. In both cases, the goal has not been solely to generate new uses in the buildings but to create new centralities supported by the large dimensions of the properties, allowing for complementary and flexible outdoor uses. This aspect highlights the effects of single buildings on the transformations of wider urban areas.

The results invite more students to work on industrial fabrics abroad as a way to expand their experiences, approach, and understanding of adaptive reuse. The contamination of different approaches in Italy and Spain to the analysis and design process is also improving the whole teaching methodology and learners' experiences. Due to the reduced number of industrial heritage remains that exist in Malaga, the target industries have to be found in the province, where several outstanding examples exist, but making more difficult the field work for students not settled in the area. The authors also look to involve other stakeholders, such as local associations promoting local industrial heritage, as a way to have more impact in the discussion on the local industrial heritage and also as a support in the analysis and decision phases.

The adaptation of these spaces for new uses, such as the integration of contemporary technologies and sustainability approaches, plays a crucial role in the socioeconomic revitalization of communities. These considerations require a scaling up beyond established experiences, as industrial heritage still faces vulnerabilities and a lack of recognition. The integration of these sites into the urban context and the connection with the local community via revitalization projects, cultural activities, and participation networks contribute to the long-term sustainability and appreciation of industrial heritage. The "Framework Convention on the Value of Cultural Heritage for Society" [36] can be considered a turning point in the involvement of local communities in the protection of cultural heritage. The concept of a heritage community is defined here for the first time, referring to a group that values specific aspects of cultural heritage that it wishes to protect and pass on to future generations. The heritage community, therefore, joins experts and professionals appointed by institutions during the analysis phase, thus expanding the range of knowledge and experiences involved in the processes of enhancing various forms of cultural heritage [37].

Therefore, the rehabilitation of industrial heritage cannot be carried out solely based on design criteria, as the subject of study is more of a system characterized by various elements and factors, not exclusively linked to the construction process. An integrated approach is required, considering a wide range of criteria, often interrelated and dependent on each other, which are, however, difficult to standardize. The experiences presented here emphasize the importance of paying attention to certain unique aspects of industrial heritage in the design phase for the proper enhancement of all tangible and intangible aspects that have defined past industrial activity. Each of these aspects can be interpreted and introduced into the project in different ways, depending on the constraints and different sensitivities of the architect involved, demonstrating the richness of nuances that a project can achieve, but also the risks that subjectivity entails.

Regarding the relationship between research and teaching in the rehabilitation of industrial heritage, it is recognized that both dimensions are fundamental. Aspects considered of great relevance in these dynamics include the complementarity of knowledge, the promotion of innovation, and the updating of methodologies that can be tested before their effective implementation in the real world. In terms of the complementarity of knowledge, the work provides new perspectives, techniques, and methods for addressing the rehabilitation of industrial heritage. By establishing a connection between research and education, it is possible to disseminate this updated knowledge among learners and professionals in training, ensuring a more comprehensive and informed approach to the restoration of these structures. Stimulating innovation involves the development of novel technologies and techniques applied to the conservation and restoration of buildings. This cultivates an innovative mindset in students and future professionals, who can contribute fresh ideas and creative solutions to the challenges presented by the restoration of these structures. The updating of methodologies is reflected in the methods and techniques used, which are constantly evolving due to advances in applied research. While the most significant advances mainly occur in the professional field due to the results obtained in real situations, it is in the academic environment where more original and transgressive proposals can be made that introduce new approaches. The integration of these new approaches into academic education allows for the identification of methodologies and intervention scales that can be transferred to the professional field. By combining the updated knowledge of the latest research with academic education, innovation, conservation, and appreciation of this cultural heritage are promoted, and appropriate methodologies for its conservation are advanced.

In summary, the relationship between research and teaching in the rehabilitation of industrial architectural heritage plays a fundamental role in the preservation and appreciation of these valuable historical structures. The criteria analyzed, without aiming to be exhaustive, are a first step in translating the meaning of the indicators proposed in numerous evaluation tools into the design process, where the territorial scale is essential for the assessment of industrial heritage.

Author Contributions: Conceptualization, G.C. and C.V.; methodology, G.C.; investigation, G.C. and C.V.; writing—original draft preparation, G.C.; writing—review and editing, G.C. and C.V.; funding acquisition, G.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Universidad de Malaga, Plan Propio de Investigación y Transferencia D2. The APC was funded by Universidad de Malaga and Dipartimeto d’Architettura, Università degli Studi G. d’Annunzio di Chieti e Pescara.

Data Availability Statement: No new data were created in this study. Data sharing is not applicable to this article.

Conflicts of Interest: The authors declare no conflict of interest.

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