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Industrial Archaeology
European approach to recovery productive memory

Mara Capone, Noelia Galván Desvaux
Luis Agustin-Hernandez, Lucas Fernández-Trapa

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BLENDED INTENSIVE PROGRAMME
Industrial Archaeology. European approach to recovery productive memory

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Table of contents

Table of contents

Table of contents

Preface

Michelangelo Russo
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The landscape of our cities has undergone a dramatic transformation since the mid-20th century. The shift from an industrial to a service economy, driven by urban development and the search for new economic models, has profoundly impacted both the economic and physical shape of our cities. As industries migrated from city centers, motivated by growing environmental concerns and the need for sustainable practices, they left behind vast, often imposing structures of metal and stone. These former industrial zones, once lively hubs of activity, became isolated areas due to neglect, lack of intervention, and the lingering effects of heavy pollution. However, the growing emphasis on sustainability and preservation has ignited a renewed interest in architecture and urban planning. These concepts have reshaped our approach to the built environment, prioritizing environmentally friendly practices, respect for existing structures, and the creation of spaces that better serve the needs of the population. As a result, cities are now focusing on integrating more green areas and developing creative strategies to repurpose these industrial sites.

Funded by the European Commission under the Erasmus+ Programme, the Blended Intensive Program (BIP) is a collective effort by Federico II University and partner institutions Hochschule Koblenz (Germany), Universidad de Valladolid (Spain), and Universidad de Zaragoza (Spain). It builds upon a profound commitment to preserving and fostering a deeper understanding of Europe's rich industrial legacy. The program aims to bridge the gap between the past and the present, illuminating

the cultural, historical, and architectural value of industrial sites. The project embraces an experimental approach to architecture and design, considering historical, social, and environmental aspects.
The transformation of the ex Corradini in San Giovanni a Teduccio is the targeted area of BIP workshop activities. These activities involved students from Spain, Germany, and Italy who worked together to visualize the San Giovanni district by testing different methods to define proposals for the district's regeneration, to finally aim to create a multifunctional area with urban life diversity in a post-industrial era.
Events detailed in this book include workshop activities and seminars aimed at educating stakeholders about the cultural, historical, and architectural value of industrial heritage sites. Presentations by experts engage the public and encourage participation, exploring topics such as heritage conservation principles, adaptive reuse strategies, and community engagement approaches.
BIP activities complemented the Abit, InhAbiting the Transition, an innovative project led by the Department of Architecture (DiARC) at the University of Naples Federico II. It focuses on adapting living spaces and models towards more sustainable settlement, production, and consumption patterns. Abit's vision holds the transition as a critical stage, demanding the adaptation of living spaces and models in response to this critical moment. It's an evolutionary process extending from the immediate challenges of the short term to the far-reaching transformations of the long term.
In these regards, the BIP was focused on comparing different European approaches to urban regeneration of industrial areas. This book offers a comprehensive overview of the developed activities, aiming to capture the extensiveness of research conducted by DiARC academics on abandoned industrial areas. With a particular focus on the ex Corradini site, the book delves into the program's efforts to achieve inclusive and interdisciplinary understanding of this critical topic.
The transformation of the ex Corradini has been the subject of study for some time, in particular part of the industrial site is involved in the

project drawn up by the Municipality of Naples called "Completamento del restauro degli edifici di archeologia industriale ex Corradini a San Giovanni a Teduccio", for which funding has been allocated.

The book, therefore, has the merit of focusing attention on the urban transformation of the San Giovanni district with the aim of continuing the trend of "urban acupuncture" interventions, which have allowed the partial reactivation of the economy by exploiting the district's potential. Two important interventions have already been carried out: the reconversion Locomotive Factory into the Pietrarsa Railway Museum and the reconversion of the ex Cirio factory into a multifunctional University Center. The ex Corradini's transformation project could be the third urban regeneration project in this area in the next future.

Therefore, the dissemination activities related to the BIP Industrial Archaeology project are crucial for fostering a cultural dialogue about the broader topic of transitional urban spaces. These activities play a key role in sharing knowledge, raising awareness, and engaging stakeholders in the transformation of industrial heritage site.
This book, along with all the related events, will be an important contribution to the regeneration process of San Giovanni district and the work will become a valuable resource for scholars and anyone interested in the preservation and adaptive reuse of industrial heritage sites.

Introduction
Mara Capone
BIP Coordinator

The topic of the disused Industrial Heritage has been the subject of a Blended Intensive Programme (BIP), financed by European Commission in KA131 Mobility of higher education students and staff supported by internal policy funds projects, in which the Federico II University of Naples has played the role of Coordinator.
BIP Industrial Archaeology was developed and implemented in cooperation with three Universities from EU Member States: the Hochschule Koblenz (Germany), Universidad de Valladolid (Spain) and Universidad de Zaragoza (Spain), associated in a Partnership with a Multilateral Inter-Institutional Agreement.
The BIP Industrial Archaeology in Naples involved 26 students and 10 Staff Mobility for Teaching from sending institutions, and 15 students from Federico II University.
Blended intensive programmes are short, intensive programmes that use innovative ways of learning and teaching, including the use of online cooperation typically refers to an educational or training program that combines both online or digital components with in-person or face-to-face interactions.
The online component involves lectures, interactive modules, discussion forums, and assignments that students complete remotely using digital platforms. This aspect allows for flexibility in learning, as students can access materials at their own pace and from any location with an internet connection.

On side. Ex Corradini, industrial heritage. Photo by Maria Ferrara, taken during the Living Lab Inhabiting the City in Transition. Evolutionary Projects for the Reuse of Large Urban Containers (curated by Orfina Fatigato and Gianluigi Freda) included in the program of the Festival of Architecture, CA23 Campania Region Architecture in April 2023.

The in-Person component involves physical meetings, workshops, labs, or seminars where students come together with tutors for hands-on activities, group discussions, presentations, or practical demonstrations. This aspect provides opportunities for direct interaction, collaboration, and deeper engagement with the material component of the topic.
Blending these two modalities offers several advantages such as:
- Flexibility: students can balance their learning with other commitments since online components can often be accessed at any time.
- Engagement: combining online and in-person interactions can share different learning approaches, enhancing overall engagement and understanding.
- Cost-effectiveness: by leveraging online resources, institutions can potentially reduce costs associated with facilities and travel.

Overall, the blended intensive approach seeks to maximize the benefits of both online and in-person learning while minimizing their respective limitations.
In a Blended Intensive Programme (BIP), research activities play a crucial role in fostering deep learning, critical thinking, and application of knowledge. The main research activities integrated in the BIP program are related to:
- Collaborative Projects: BIPs often emphasize collaborative learning and teamwork. Research activities may involve group projects where students work together to design and conduct research studies, analyze data, and present their findings. Online collaboration tools such as shared documents, video conferencing, and project management platforms facilitate communication and coordination among team members.
- In-Person Research Workshops: during the in-person component of the program, students participate in research workshops led by teaching staff from host institution and sending institutions, meeting with stakeholders such as social and cultural associations and doing surveys.

These sessions focus on research methodology, data collection techniques, ethical considerations, and presentation skills. Hands-on activities and group discussions provide opportunities for students

to deepen their understanding and receive feedback on their projects. BIP incorporates fieldwork experiences where students engage in real-world research activities under the guidance of mentors or supervisors. This practical component allows students to apply their knowledge and skills and gain valuable team research experience.
Overall, research activities in a Blended Intensive Programme are designed to cultivate students' research competencies, foster intellectual curiosity, and prepare them for careers or further study in their chosen fields. By integrating online and in-person learning experiences, BIPs offer a dynamic and immersive environment for research and scholarship.
The topic of the BIP Industrial Archaeology is the disused Industrial Heritage, both in material dimension - places/buildings - and intangible - the set of knowledge linked to the memory of the productive activity.
The programme aims to promote an innovative educational system based on an integrated approach to finding possible solutions to complex problems. Priority will be, therefore, the attention to the definition of a replicable methodology for the analysis and representation of the Industrial Archaeological Heritage especially in relation to the identification of the constituent elements (physical, intangible and landscape components) and the construction of multi-scale digital models that will allow to represent the transformation during the time, to simulate processes and to evaluate design alternatives in different contexts.
The program aims to overcome the classical specialisms of Industrial Archaeology to define "European" approach on two fundamental topics:

1. Knowledge and representation of Industrial Heritage.
2. Reuse and urban regeneration strategies definition.

The program is divided into three phases: the activities in the first phase are conducted online, the second phase is in person, and the third and final phase returns to a remote setting.
The virtual component of the program is divided into two phases: the first phase took place on February 28 and 29, 2024, and the final phase on April 29 and 30, 2024.

Fig. 1. BIP operational planning (image by tha author).

During the first online phase, seminars were organized to provide students with basic theoretical knowledge on key topics and were made available on a dedicated YouTube channel.

During the in-person phase, special meetings were held related to:
1. Methods and tools for Industrial Heritage survey and representation.
2. Methods and tools for Industrial Heritage mapping.

3. Brainstorming activity to derive design elements for urban regeneration definition.
4. Meetings with stakeholders relevant to the urban regeneration project, including local residents, community groups, and cultural associations.

The meetings were intended to accomplish two objectives: first, to define theoretical approaches and illustrate best practices; and second, to foster debate and exchange of views among students by comparing different approaches at the international level.

The structure of the meetings aimed to develop an approach to the theme of Industrial Heritage that integrates the different disciplines and encompasses multiple, cross-cutting skills. To achieve this goal, the teaching staff involved in the training pool was connected to different areas, spanning survey, drawing, representation, design, landscape architecture, and evaluation. This different expertise ensured a comprehensive exploration of the Industrial Heritage topic, addressing its complexities and enriching the learning experience for participants.

The aim of the program was to equip learners with essential knowledge to undertake the development of strategic actions for regenerating abandoned industrial contexts, beginning with the survey and analysis of the site within its territorial context.

From the outset, students were actively engaged in group work activities aimed at achieving the following intermediate objectives:

1. Mapping disused industrial areas within the city of Naples.
2. Defining criteria for cataloging Archaeological Industrial Heritage buildings.

The program concluded with an online phase held from April 29th to 30th, 2024. During this stage, concepts developed during the intensive in-person workshop were reviewed and shared for the final presentation. This phase provided an opportunity for participants to consolidate their learnings and refine their strategic approaches for the regeneration of abandoned industrial areas.

The in-person activities were structured as workshops held from April 8 to 13, 2024, at the University of Naples Federico II. The workshop provided students with the opportunity to collaborate within an interdisciplinary team to define urban regeneration scenarios for a real case study in Naples: the ex-Corradini in San Giovanni.
During the in-person activities, a tour of the study area and its surrounding territorial context was organized by teaching staff and experts. This activity was crucial in providing participants with essential information to effectively engage in the workshop activities.
Additionally, a practical laboratory was conducted by teachers from universities of the BIP Partnership, involving stakeholders such as associations and institutions. This laboratory allowed participants to apply the theoretical knowledge gained during the virtual phase of the course, as well as the specific instructions provided during the introductory phase, to the real case study.
The intensive workshop provided participants with the opportunity to collaborate with colleagues and experts in working groups. This collaborative environment facilitated discussions, idea exchange, and problem-solving, enabling participants to delve deeper into the subject matter and develop comprehensive strategies for addressing the challenges of urban regeneration.

The in-person session of the workshop was structured around the following themes:

- Advanced Architectural Survey Techniques: Participants learned and applied advanced procedures for acquiring and processing architectural survey data to create interoperable 3D models representative of the case study. These digital representations facilitated the analysis of key issues and relationships between disused sites and their urban context, both built and natural.
- Spatial Data Visualization Techniques: Participants experimented with digital modeling techniques to visualize spatial data, ranging from the territorial scale of the landscape to the architectural scale. This enabled

them to integrate and support interpretative analyses of the abandoned contexts under examination.

- Construction of Physical Models: Participants engaged in constructing physical models to study the territorial context and the area of the ex-Corradini factory.
- Roundtable Discussions with Stakeholders: Organized and facilitated roundtable discussions involving potential stakeholders to gather community input and solicit feedback from investors interested in the sustainable recovery and reactivation of abandoned industrial complexes.
- Development of Communication Devices: Participants designed communication devices and disseminated analysis and project concepts using digital multimedia systems such as augmented reality (AR) and virtual reality (VR) applications, as well as virtual exhibitions.
- Participatory Concept Elaboration: Brainstorming activities engaged students in participatory concept elaboration to define a range of possible regeneration actions for the examined area and its related abandoned buildings.

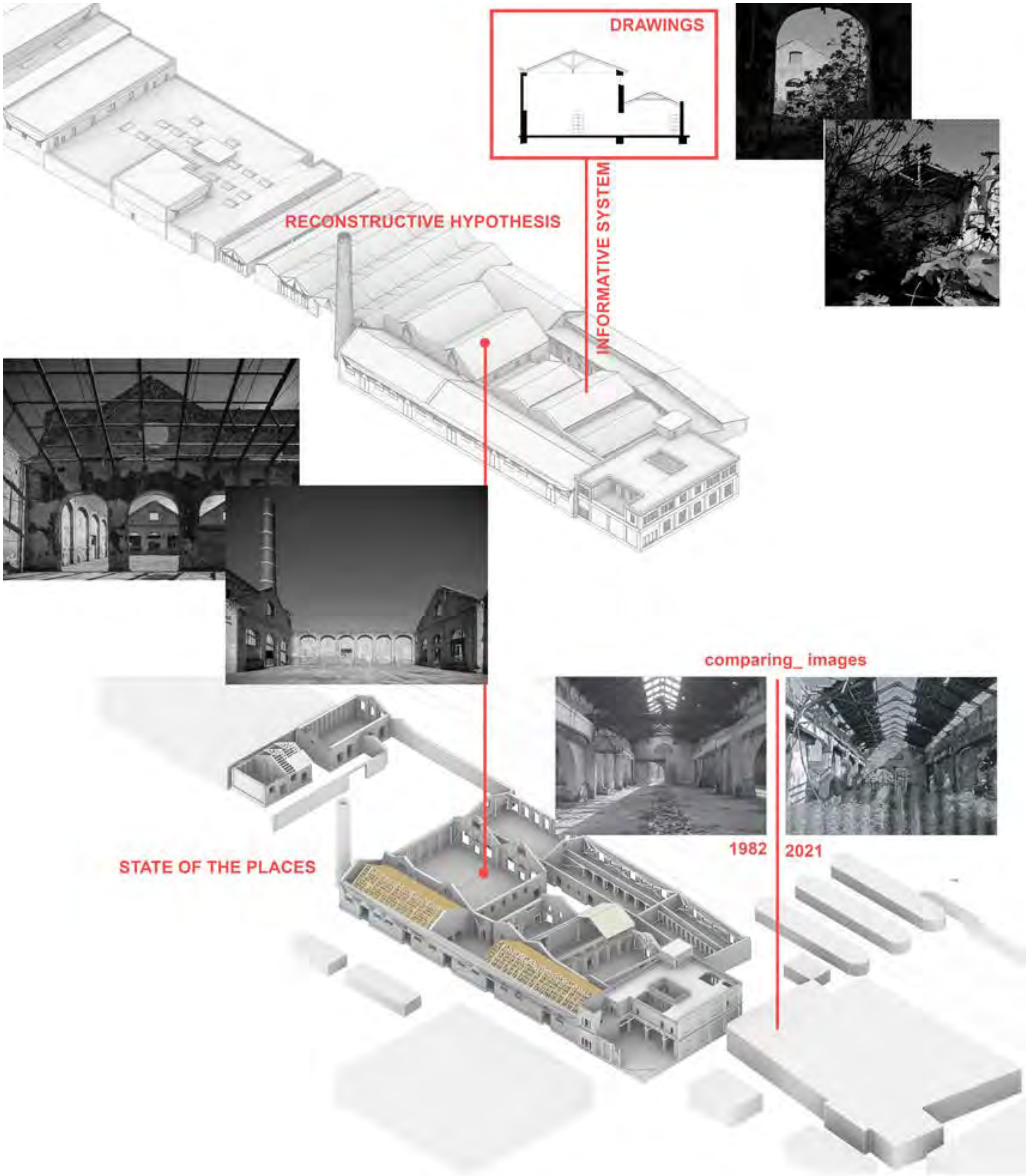
At the end of the BIP we are planning some dissemination activities that are crucial for sharing knowledge, engaging stakeholders, and raising awareness about urban regeneration projects. We are going to organize international events in order to compare different approaches in relation to the main topics and local events in order to engage stakeholders and promote dialogue about the urban regeneration project, that will include presentation of workshop activity results, community meetings, walking tours, and public exhibitions or installations.

CHAPTER 1
Methodology
Mara Capone

In this session, we have collected papers addressing the main methodological issues in Industrial Archaeology. These contributions emphasize the importance of an integrated approach involving disciplines such as drawing, history, urban planning, design, and urban regeneration. These collectively provide a framework for addressing the complexities of Industrial Archaeology and developing innovative solutions for the regeneration of abandoned industrial areas that have great iconic value but are often polluted and inaccessible. To tackle these challenges and consider the value of abandoned industrial sites under national and European laws, a framework has been defined addressing several critical aspects:

- **Ex industrial sites valuation**: establishing criteria for attributing cultural, historical, and economic value, recognizing their significance in heritage preservation and urban regeneration.
- **Legal and regulatory context**: understanding laws that enforce protection and provide guidelines for adaptive reuse.
- **Heritage knowledge**: gathering detailed information about the sites, including historical context, architectural features, and previous functions.
- **Quantitative and qualitative representation**: using advanced survey techniques and digital tools to create detailed site representations that facilitate analysis and planning of future interventions.
- **Intervention strategies**: analyzing sustainable reuse strategies, including adaptive reuse, conservation, and integrating new functionalities while preserving historical value.

On side. Ex Corradini, industrial heritage. Photo by Maria Ferrara, taken during the Living Lab Inhabiting the City in Transition. Evolutionary Projects for the Reuse of Large Urban Containers (curated by Orfina Fatigato and Gianluigi Freda) included in the program of the Festival of Architecture, CA23 Campania Region Architecture in April 2023.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Analysis, drawing, project.
Tools and methods to manage the Industrial Heritage transformation

Mara Capone

Abandoned industrial areas can be represented and reimagined inclusive, and sustainable urban spaces in relation to their past and their future potential by employing a multidisciplinary approach that integrates documentation, mapping, historical research, conceptual design, community engagement, environmental assessment, and cultural interventions

One of the main goals of this research project is to evaluate various visualization techniques concerning the transformation of Industrial Heritage. The aim is to demonstrate how survey and representation play a crucial role in the regeneration process of abandoned industrial sites with historical value.

Representations such as drawings, physical models, and digital simulations allow stakeholders to visualize abstract concepts and ideas, making them easier to understand and to evaluate different proposals. Visualization tools encourage innovative thinking and experimentation, allowing designers to explore a range of possibilities for the site's redevelopment. Therefore, knowledge is the first step preserving historical memory (Fig. 1).

When developing a design proposal within the constraints of protective restrictions, it's essential to undertake a process to identify the elements that can be effectively integrated.

Survey and Analysis of the site, including any existing structures, the natural features, historical significance, and regulatory restrictions, help you understand the elements present and what limitations or requirements

Fig. 1. Information system design. Raprenting transormations (image edited by Mara Capone).

you must adhere to. These analyses allow you to identify elements that you can demolish and what you must preserve. These could include deteriorating structures, non-historic buildings, or features that area not compatible with proposed design vision. Evaluate the elements that must be preserved due to protective restrictions is crucial. By understanding the reasons behind these restrictions and how they influence your design approach is the first step of the design work. With a clear understanding of what can be demolished and what must be preserved, you can begin planning how to integrate these elements into your design proposal, by considering how new structures can complement existing ones, how to incorporate historic features into modern designs, and how to minimize impact on preserved areas. It can be the starting point to explore creative solutions to challenges posed by the preservation requirements. This could involve adaptive reuse of existing structures, innovative building techniques to blend old and new, or designing around sensitive environmental features.

By starting with a comprehensive understanding of the site and its context, you can define collaboration and consultation step that will support the goals of the design proposal. Working closely with relevant stakeholders, including preservation authorities, local communities, and clients, throughout the design process you can define different possible solutions. Their input and expertise can help ensure that your proposal meets regulatory requirements while also addressing the needs and concerns of all parties involved.

Starting from this fundamental assumption, some of the fundamental issues concerning representation were addressed with particular attention to the issue of tools and, therefore, interoperability and detail, such as the problems connected to different methods of displaying models and the methods of interactive use of these models.

Interactive 3D Models: sharing Data

3D visualization for heritage sites offers benefits, facilitating a deeper understanding of historical contexts and serving as a potent tool for

preservation. Interactive visualization methods open novel avenues for sharing information and presenting heritage sites to the public, transcending barriers of age and background.
You can create detailed reconstructions of heritage sites, providing insights into their original appearance and historical significance. The interactive models can incorporate layers of contextual information, such as historical events, architectural evolution, and cultural relevance, enriching the user's understanding.
3D visualization can create detailed reconstructions of heritage sites, providing insights into their original appearance and historical significance. The interactive models can incorporate layers of contextual information, such as historical events, architectural evolution, and cultural relevance, enriching the user's understanding.
Interactive 3D models engage users in a more dynamic learning experience, making historical information accessible and engaging for a wider audience. 3D visualization allows people worldwide to explore heritage sites remotely, breaking down geographical barriers and making heritage accessible to a broader audience. Interactive models can be designed to cater to diverse audiences, including children, elderly individuals, and people with disabilities, making heritage education inclusive.
Moreover, 3D models facilitate collaboration among researchers, allowing them to share and analyze data more efficiently.
Working on interactive 3D models and various visualization modes has proven to be a significant aspect of our research project. By testing and implementing methods for sharing these models through online platforms and mobile apps, we have successfully made them accessible to a global audience. This approach not only enhances understanding and preservation of heritage sites but also fosters greater public engagement and educational opportunities.
Starting from the early tools that allowed the use of 3D models as interactive interfaces to share information, such as the 3D PDF (Capone, 2013), the advances in this field are closely linked to technological evolution. The 3D PDF was one of the pioneering tools that enabled

users to embed interactive 3D models within PDF documents. It allowed users to rotate, zoom, and interact with 3D models directly in a PDF reader, making it easier to share and present complex spatial information. Despite its innovative approach, 3D PDFs had limitations in terms of rendering quality, file size, and the level of interactivity compared to modern solutions.

Technological Evolution and Advancements are based on Web-Based systems. The advent of HTML5 and WebGL enabled the embedding of interactive 3D models directly into web pages, allowing for seamless online access without additional plugins. Platforms like Sketchfab and Three.js emerged, offering robust tools for hosting and interacting with 3D models on the web.

You can design the information system using interactive elements such as clickable hotspots, annotations, and embedded multimedia (videos, audio clips, images) are integrated to provide a richer, more informative experience.

The evolution of tools for using 3D models as interactive interfaces to share information, from the early 3D PDFs to today's advanced web-based platforms, mobile apps, and VR experiences, has been driven by technological advancements. These tools have significantly improved the accessibility, interactivity, and richness of 3D models, making them powerful mediums for sharing information about heritage sites and beyond. As technology continues to evolve, we can expect even more innovative and immersive ways to interact with and share 3D data (Fig. 2).

We can trace an ideal history of the methods used for defining interactive 3D model interfaces and web-based sharing, but the main steps of the workflow have remained largely unchanged (Capone, 2016). This applies whether we limit ourselves to the interactive use of the model or explore the different methods of web-based sharing (Capone, 2012). The key stages in this workflow are always the same:

- 3D Model Generation
- Information system based on 3D interface
- Visualization modes definition.

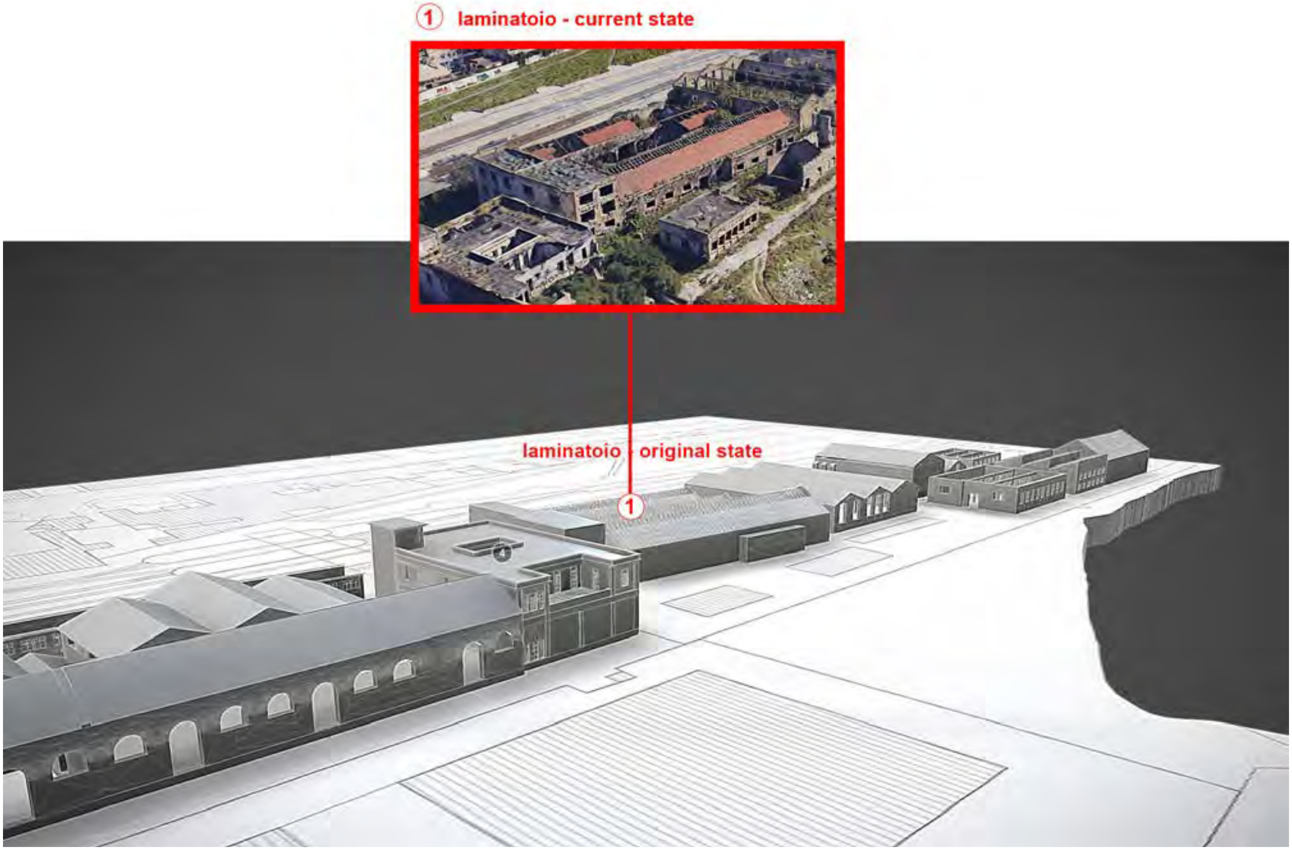
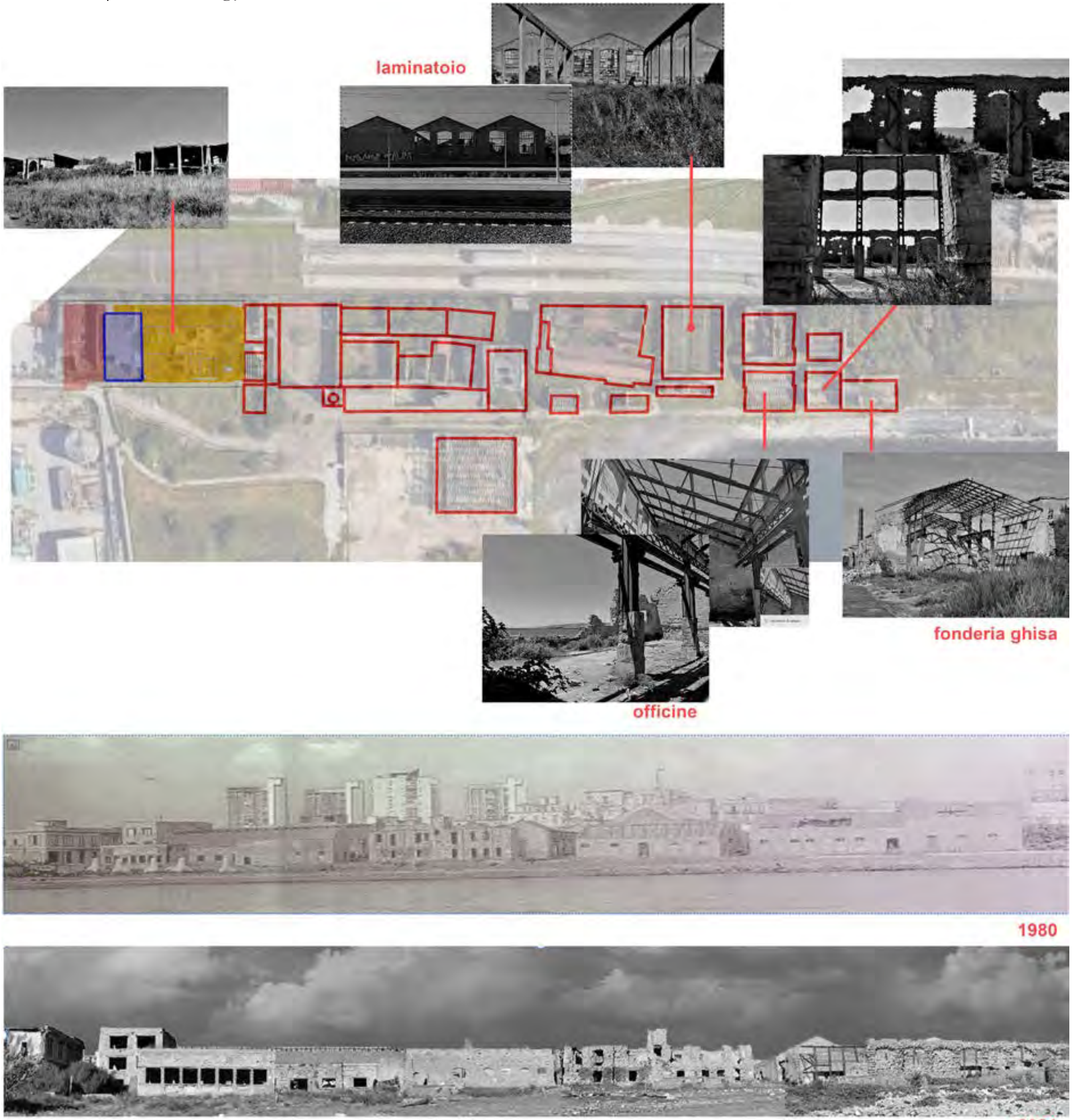


Fig. 2. Web sharing data (image edited by Mara Capone).

The workflow for creating and sharing interactive 3D models has remained fundamentally unchanged over the years, encompassing model generation, information integration, and varied visualization modes. The evolution of technology has enhanced each of these stages, making the models more detailed, the information systems more robust, and the visualization modes more immersive and accessible. However, the way in which the model is displayed remains a crucial aspect of this process, impacting user engagement, educational value, accessibility, and analytical capabilities.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3d Visualization options_ methods_problems_strategies

The visualization of 3D models for historical heritage presents a unique set of cultural and operational/instrumental challenges. Addressing these issues effectively requires a balanced approach that integrates technological innovation with cultural sensitivity.

Contemporary rendering technologies empower the creation of highly realistic 3D models, effectively depicting historic buildings and landscapes. While these renderings may convey a sense of certainty about the presented historic site, it is important to acknowledge that they might be based on spectacularization about its appearance. This is where non-photorealistic rendering offers a compelling alternative.

Non-Photorealistic Rendering, offers a wide range of illustrative styles that can be experimented with, allowing for creative expression without the pressure to adhere strictly to realism. This flexibility enables the communication of uncertainty about a site's past existence through stylistic elements such as sketchiness, fuzzy edges, transparencies, and saturations (Capone, 2011). Moreover, 3D visualization of historic sites can experiment stylistically to convey temporal aspects and changes over time (Brusaporci, 2017). This transforms the visualization from a mere illustrative representation of the past into a complex translational tool. In this context, 3D images serve not only as iconic representations but also as tools for conveying scientific data acquired through research (Ackerman, 2023). The integration of 3D modeling and non-photorealistic in heritage visualization represents a dynamic approach that encourages exploration, interpretation, and dialogue. It not only enhances our appreciation of the past but also inspires innovative approaches to proposal design. Instead of creating detailed building models, we have to define a process to simplify buildings modelling in relation to representation needs and visualizations aims.

The process of creating detailed 3D models for heritage sites involves several stages, from data collection to model generation, and addresses the challenges of interoperability.

By using a variety of software and ensuring the interoperability of

Fig. 3. Connecting data to represent transformation (image edited by Mara Capone).

models, heritage projects can effectively handle heterogeneous data from different sources. This approach not only enhances the accuracy and detail of the models but also supports collaborative efforts and long-term preservation of cultural heritage data.

Data can be edited, and models can be generated using different tools tailored to specific needs, whether it be BIM tools for detailed architectural modeling or CAD tools for more general design work. Ensuring that models created with different software are interoperable is crucial. This allows for seamless integration and manipulation of models from various sources.

Heritage projects often involve heterogeneous data from different sources, which may not be immediately compatible with each other. Establishing standards and protocols for data exchange and model integration is essential to manage this diversity effectively.

For example, interoperability and simplification are key considerations when working with BIM models for visualization purposes. By reducing the level of detail and converting models to widely supported formats, it is possible to create efficient and compatible 3D visualizations that meet the defined criteria. This approach ensures that the visualizations are not only accurate but also optimized for performance and accessibility in relation to needs.

One effective strategy is to simplify the geometry of the model by reducing the level of detail (LOD). This involves removing unnecessary details that are not essential for visualization purposes.

For examples, removing small elements like screws, bolts, or minor fittings that do not contribute to the visual integrity of the model, simplifying complex decorative features that might not be visible or important in the context of the final visualization and eliminating fine textures that are not needed for the overall appearance, thus reducing the file size and complexity.

BIM software typically uses proprietary file formats that may not be directly compatible with visualization software. You can convert BIM files to more widely supported formats such as OBJ but sometimes you

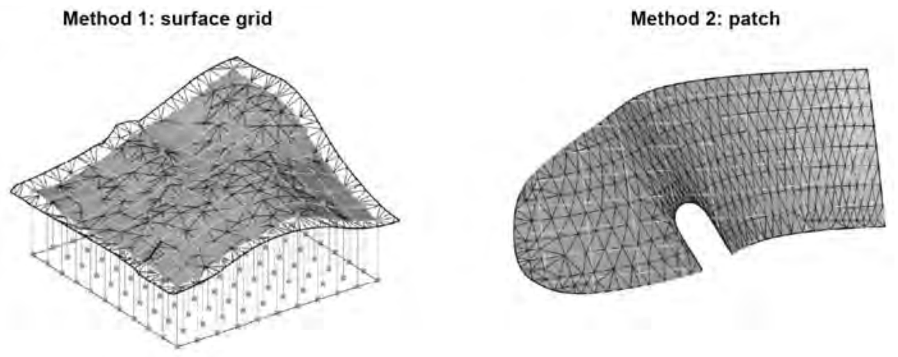


Fig. 4. eComutational approach to convert a mesh model in a nubs model (image edited by Mara Capone. Source: https://hopific.com/mesh-to-surface-ingrasshopper).

can obtain a 3D model with more information you need, and you cannot use this model to obtain the visualizations that meet the defined criteria. You can export the model from BIM software (e.g., Revit) to a widely supported format like OBJ or FBX. During this export, you can choose to simplify the model by selecting lower LOD settings if the software supports it and you can use the tools available in the visualization software to further reduce the complexity of the model, if necessary. This might involve decimating meshes, merging vertices, or simplifying textures, for example.

In the context of addressing interoperability and simplification of BIM models for visualization, a computational approach was tested by transforming complex mesh geometries into more manageable NURBS (Non-Uniform Rational B-Splines) representations.

The geometry is crucial in reusing metadata from different sources, mesh geometry is a common exchange currency for 3D models. Mesh data, while it can be stored in a CAD native format, often is exchanged or shared in a neutral format such as STL or OBJ. You can import or export geometry (solid, surface, or mesh) in OBJ, STL, or DWF format but when you are going to use a mesh model to define different visualization mode sometime there are a lot of limitations. One of the main limitations for mesh visualization option is related to mesh edges because they can be invisible, or they are all visible by default.

Converting a 3D mesh model into a 3D NURBS model offers a methodologically approach for simplifying geometry, improving efficiency, and enhancing the quality of visualizations. It's particularly affordable when dealing with planar surface, in this case NURBS surfaces offer a more streamlined representation compared to complex triangulated meshes. Converting a mesh model into NURBS allows for the creation of smooth, continuous surfaces that accurately represent the original geometry while reducing, in this case, the overall complexity of the model.

Planar surfaces, such as façades, walls, or floors, can be represented with single NURBS surfaces, even if they have openings or holes. This simplifies the model structure and makes it easier to work with.

Understanding the differences between meshes and nurbs surfaces is crucial for determining how to convert one to the other. A mesh is a collection of vertices, edges, and faces that define the shape of a 3D object. It is typically composed of triangular or quadrilateral faces connected by edges, forming a network of polygons. Meshes are commonly used to represent complex geometries with irregular shapes, as they can accurately capture intricate details and contours.

A surface is a mathematical representation of a 2D manifold embedded in 3D space.

Surfaces are defined by mathematical equations or parametric functions that describe their geometric properties, such as curvature, smoothness, and continuity. Unlike meshes, nurbs surfaces do not have discrete elements like vertices, edges, and faces; instead, they are continuous and smooth.

Before converting a mesh into a nurbs surface, it's often beneficial to simplify the mesh by reducing its complexity. This can involve techniques such as polygon reduction, edge collapse, or decimation to reduce the number of vertices and faces while preserving the overall shape and features of the mesh. Once the mesh is simplified converting a mesh to a surface may involve manual modeling techniques, where designers use surface modeling tools to recreate the shape of the mesh using parametric

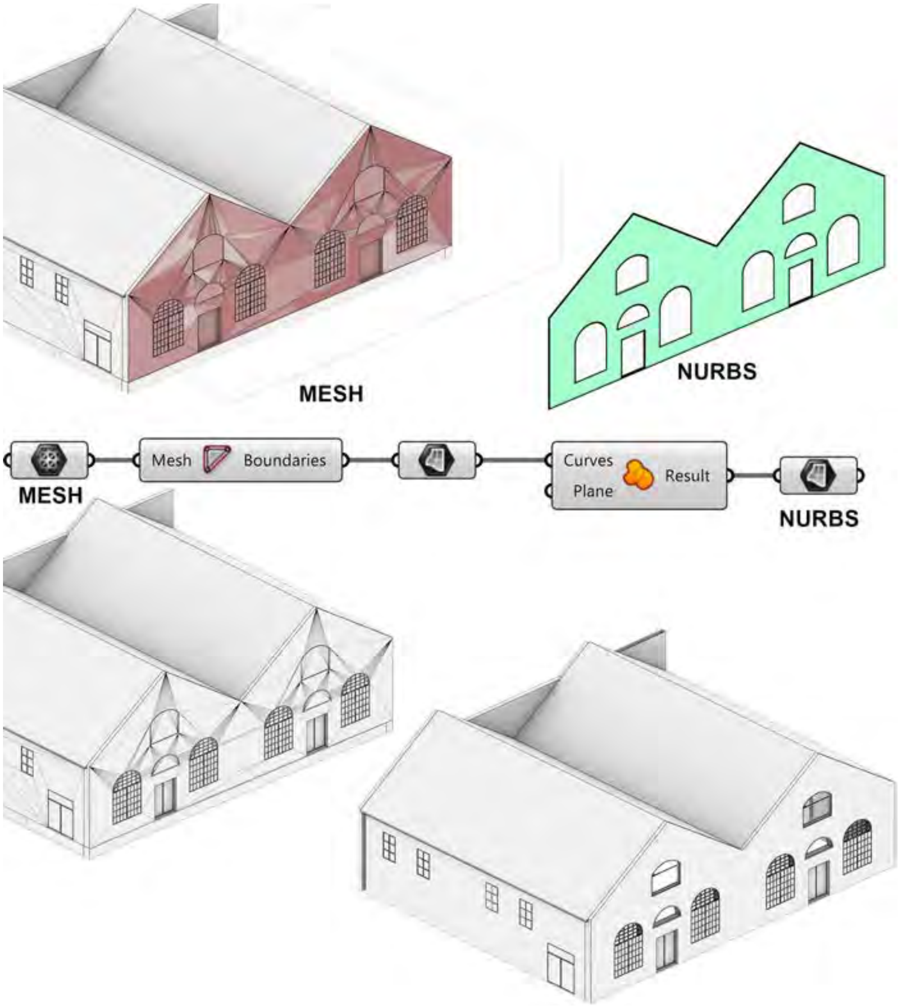


Fig. 5. Algorithm defined by Mara Capone to convert mesh model in nurbs model. Testing using Corradini model from BIM (image edited by Mara Capone).

surfaces. This approach can be more time-consuming and labor-intensive. You can generate a continuous surface representation from the mesh data using a computational approach to solve this problem, by defining reconstruction algorithms that allow you to reconstruct the surface in VPL. These algorithms analyze the connectivity of the mesh vertices

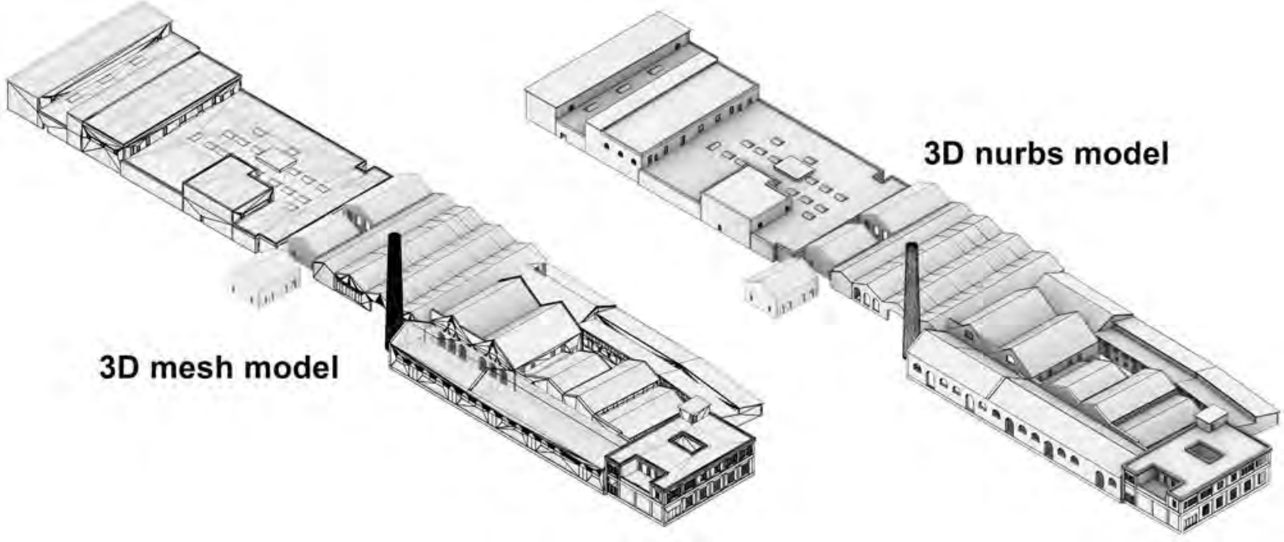


Fig. 6. Testing using Corradini model from BIM (image edited by Mara Capone).

and use interpolation or approximation techniques to construct a smooth surface that closely matches the original mesh geometry

Breaking down the process of transforming a mesh into a nurbs surface into systematic methods makes it much more manageable. By exploring techniques such as resampling the surface from scratch and using the Patch component, designers can weigh the advantages and draw-backs of each approach.

From a methodological standpoint, understanding these nuances is crucial for selecting the technique that best aligns with the specific needs of the project. Whether prioritizing accuracy, efficiency, or flexibility, having a clear understanding of the available options allows for informed decision making.

This experimentation activity serves the main goal of not only mastering the technical aspects of transforming meshes into nurbs surfaces but also developing a deeper understanding of how to apply these methods effectively in representation and visualization process.

Starting from these premises, we defined a script to simplify the meshes

in the models import-ed from BIM software. This was also an interesting opportunity to experiment with the potential and advantages offered using computational tools.
Experimenting with such tools not only expands your skill set but also enables you to explore innovative approaches to design and visualization.
The challenges of converting mesh to nurbs surface using a computational approach depends on the way meshes and surfaces are constructed.
Since the two 3D modelling techniques are so different, there is no one way to create a conversion from one to the other. It's important to understand that any conversion will lead to a compromise in accuracy, speed or usability of the resulting output.
You can define two different techniques (Fig. 4) to convert a mesh to a surface suited best for a specific use.
The kind of mesh you are trying to convert, and what you want to do with the resulting surface will determine which method to use.
Imagine you have an extremely detailed mesh, for example, a terrain model with several hundreds of thousands of faces. You just need a small portion of the terrain, and you want to convert it to a surface, so modelling it will be easier and the cleaner.
Turning the mesh into a polysurface is not an option: the sheer number of mesh faces would lead to a huge, slow file.
In this case you can define a regular grid of points and generate a surface from this grid. It is very simple drawing a rectangle in the top view that defines the area to convert into a surface (Tait, 2023).
Subdividing the rectangle to generate a grid of points. Finding the vertical intersection between those points with the mesh you can use those intersection points to generate a single clean surface (Tait, 2023).
In some cases, you want to convert a mesh with non-regular boundary to a surface in order to get a clean and precise trimmed surface. The previous method doesn't work in that case: the Surface Grid approach requires a rectangular, planar outline.
You can extract all the vertices from the mesh and use them as the input for a Surface patch. The surface patch will fit a surface through all the

points provided, even if they are in a random order. Because the surface patch will create a surface that goes beyond the points we specify, we'll need to trim it using the original border.
The case study is simplest than the two samples we have analyzed because all the mesh faces are planar. In this case the process is based on deconstructing the mesh in its faces and connecting them using a Boolean union of the regions. If there are holes, we can use Boolean difference.
From a methodological point of view our goal is to demonstrate how the computational approach can help you to solve some specific problems, in this case we have defined a customized tool to manage heterogenous geometry models.
We tested the defined algorithms to explore different visualization options and to create a coherent 3D model of the case study (Figg. 5,6).
In conclusion, the themes addressed in this contribution underscore the importance of testing the limits and potential of different representation methods to manage transformation processes. Through our exploration of various visualization techniques, we have highlighted the need for accurate, clear, and integrative representations that can effectively communicate complex data and changes over time. Our findings suggest that while each method has its strengths and weaknesses, a nuanced understanding of their capabilities can lead to more informed and effective applications in Heritage management. Moving forward, continued experimentation and refinement of these representation methods will be essential in advancing our ability to manage and visualize transformation processes in diverse contexts.

Notes

[1] The study was carried out as part of a degree thesis entitled Aree industriali dismesse: il caso di Bagnoli. Tutor Prof. A. Baculo Giusti, co-tutor Prof. A di Luggo, candidate A. Mosca, 2004.

References

Ackerman, A., Auwaerter, J., Foulds, E., Page, R., & Robinson, E. (2023). Cultural landscape visualization: The use of non-photorealistic 3D rendering as an analytical tool to convey change at statue of liberty national monument. In *Journal of Cultural Heritage,* Vol. 62, pp. 396-403.

Apollonio, F. I., Giovannini, E. C. (2015). A paradata documentation methodology for the Uncertainty Visualization in digital reconstruction of CH artifacts. In *SCIRES-IT*, Vol. 5, No. 1, pp. 1-24.

Brusaporci, S. (2017). The Importance of Being Honest: Issues of Transparency in Digital Visualization of Architectural Heritage. In A. Ippolito (Ed.). *Handbook of Research on Emerging Technologies for Architectural and Archaeological Heritage,* pp. 333-360. Hershey: IGI Global.

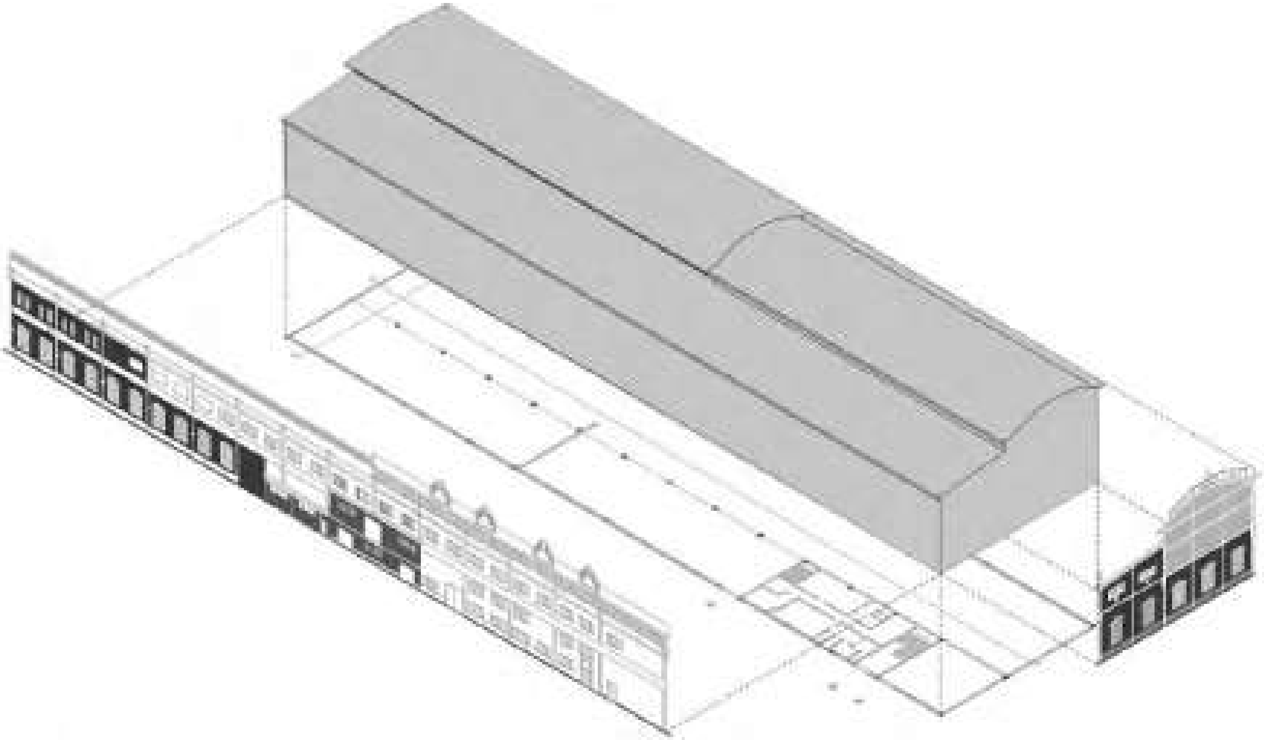
Capone, M. (2011). Archeologia Urbana. Rappresentare l'incertezza: gli scavi archeologici di Piazza Bovio a Napoli. In *DISEGNARE CON,* No.7, pp. 68-80.

Capone, M. (2013). Interactive communication for Architecture and Design Interfaces for an information system based on 3D representation. In R. Florio (Ed.). *MAED Materioteca fisica e virtuale per l'architettura e per il design*, pp. 285-300. Pozzuoli: Paparo Edizioni.

Capone, M. (2016). Interfacce tridimensionali interattive. Percorsi alternativi per la lettura Castel Nuovo. 3D interactive interfaces. Alternative routes rediscovering Castel Nuovo. In M. Losasso, & M. Campi (Eds.). *Conoscenza e valorizzazione del patrimonio culturale del Centro storico di Napoli. ABITARE IL FUTURO,* pp. 154-167. Napoli: Clean.

Capone, M., & Lanzara, E. (2021). Artefatti cognitivi interattivi web-based: edutainment per il patrimonio culturale. In A. Arena, M. Arena, M., D. Mediati, P. Raffa, P. (Eds.). *Connecting – Drawing for weaving relationship. Linguaggi, Distanze, Tecnologie,* pp. 2119-2136. Milano: FrancoAngeli Open Access.

Tait, T. (2 July 2023). Mesh to Surface in Grasshopper: A Comprehensive Guide. <https://hopific.com/mesh-to-surface-in-grasshopper/> (accessed 30 April 2024).



Digital models for industrial building knowledge

Simona Scandurra, Daniela Palomba, Antonella di Luggo

Introduction

The disused industrial heritage constitutes tangible evidence of the material culture of past eras, knowledge of which helps to understand the identity of places and the transformations of territories. It is a heritage made up of abandoned manufacts, often in a precarious structural condition, which over time have taken on a specific cultural value and for which, more and more often, processes of valorization and reconversion are being considered.

The metric and material survey, as well as the survey of construction technologies, the state of conservation and the analysis on a territorial scale of these manufacts, make it possible to prepare multidimensional documentation, useful for an in-depth and articulated understanding on several levels of knowledge and constitute the information base necessary for the formulation of any transformation hypothesis. In fact, these representations are capable of including data of a different nature and at different scales, from those relating to architecture and construction details to those on a territorial scale, contemplating the various singularities and the historical, cultural, social and environmental context of reference. Alongside this, representation plays a fundamental role in decision support, revealing specific aspects of the built reality and making manifest its vocation for transformation, while at the same time allowing for the preservation of its memory.

Moreover, in the contemporary world, representation takes on a position

Fig. 1. Mechanical manufacturing building in Bagnoli, Naples (model by A. Mosca).

of great importance thanks to digitization techniques and archiving on platforms that integrate and correlate data of different natures using effective tools and methods to document, analyze and communicate the specificities of each manufact. In particular, digital models enable interactive visualization and comprehensive information management at different scales of detail, such as BIM models that introduce innovative approaches to knowledge, integrating geometric data with historical data and diagnostic information within a single context.
Through a review of the literature and the analysis of the most used procedures in the field of digital technologies, referring to some case studies referable to the disused industrial heritage in the Campania region, the contribution explores different methods for the realization of representation products, capable of conveying, through figuration, fundamental information data for the documentation of the asset.

The representation of disused industrial sites in the Campania region: graphic models

The city of Naples sees its coastline strongly characterized, both on the western and eastern sides, by the presence and construction, over a long period of time, of buildings and pavilions intended to house various industrial-type settlements. Such a location is obviously linked to strictly practical issues arising from logistics and thus the movement by sea of supplies and obviously also of what was produced there. The declination to the past reflects the current condition that sees many of these settlements, now unused [1]. The reclamation of these sites, their reuse and re-functioning, is an issue that is always alive and well in intervention policies on an urban and architectural scale. While the constellation of industrial-type settlements on the Neapolitan coast has strongly marked the landscape and given a precise connotation to these places, it has in certain respects protected them from major concrete interventions. The most emblematic case is the former industrial area, located on the Coroglio plain, which for over a century - since 1905 - housed the factories of the former Ilva then Italsider, active until 1992. An area that

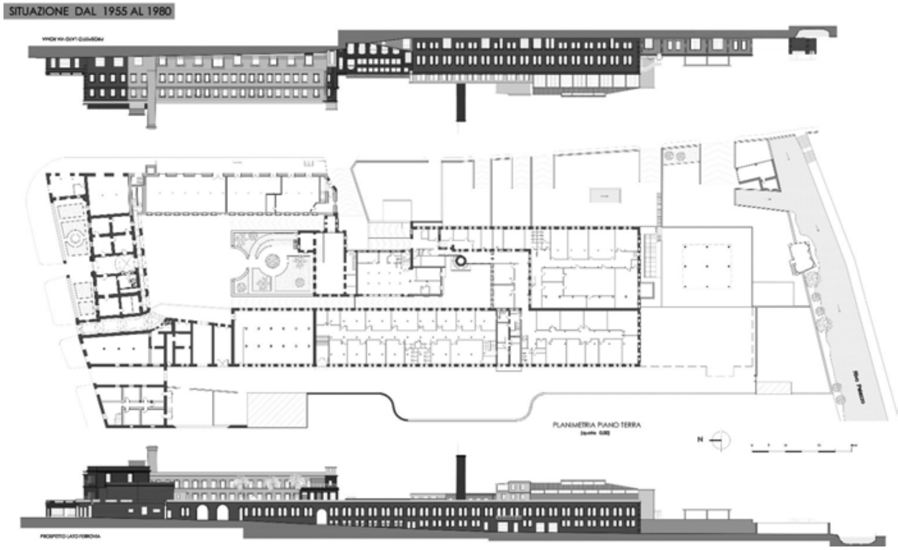


Fig. 2. Buchy and Strangman, textile and spinning mill in Sarno (drawing by A. Mazziotti, A. Marzullo).

is still waiting, for more than thirty years, for concrete actions aimed at its redevelopment. In this context, the role of survey, representation and knowledge are the way in which the discipline of Drawing, considered in an extended sense, proposes itself as a tool capable of preserving the memory of places that may be destined for abandonment, rather than for modification. These are productive realities that have significantly affected the image of the territories and the lives of the people who lived there. It is therefore necessary to address the issue of preserving the memory of these realities.

The images of these sites are often identified with manufacts that have become iconic for the landscape that hosts them. In the case of Bagnoli, this is the case of the great Steelworks which now seems to belong, with its great mass characterized by its dark red colour, to that landscape. The plain is now a different place, a place very different from the image that characterized it for over ninety years. What was once a dense tangle of warehouses is now a large desolate area dotted with a few manufacts scattered haphazardly around. The long boundary wall that perimeters the area, however, leaves room for the view of here tall manufacts, the chimneys, the extinguishing tower and the blast furnace. As part of a study conducted on the area in early 2004, a mapping exercise was carried out to analyse the intrinsic qualities of the manufacts connected to the characteristics of the architecture and the relational qualities referring to the manufact/context relationship, each of them being significantly present elements, as well as concrete evidence of a time gone by. The survey delved into the representation of some of these manufacts and in particular: the Agl Chimney, the Mechanical Workshop and the extinguishing tower.

The selected cases offer an exemplification of different structural configurations, referable to manufacts with a prevalent vertical development, with a repetitive modular scheme, rather than presenting a completely singular conformation that highlights the plastic possibilities of reinforced concrete that conforms atypical objects that find their reason for being in other motivations of a functional nature. For the first two cases, the structural scheme is legible and declared. The reinforced concrete framework and the facing brickwork draw the texture of the façade, offering useful indications for a proportional reading of the compositional and geometrically dimensional components.

But examples of industrial settlements, of sites that can be counted among the 'heritage' of industrial archaeology, multiply and can now be found throughout Campania. By way of example, but also because of its value as a building of historical and cultural interest, we would like to mention the Pratola Serra paper mill in the province of Avellino. Its origin dates back to 1924 and once again it is a building whose refunctioning and recovery has been debated for years. It is a masonry building of great charm characterized by a compositional rhythm designed on the façade by narrow curved windows and the sequence of the wooden trusses of the roofs. In this case too, the survey activities conducted are proposed as a basis to support possible projects, but also to stop - albeit in the digital dimension - the memory of its presence.

Fig. 3. Evolution of Buchy and Strangman building in Sarno (model by A. Mazziotti, A. Marzullo).

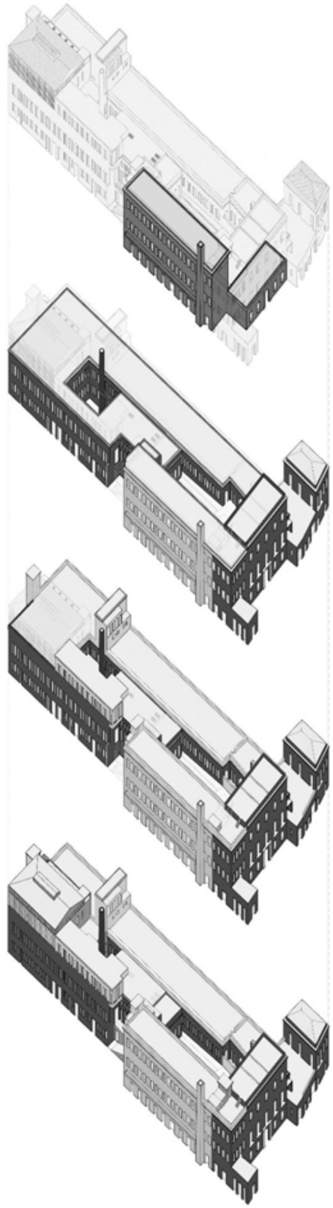
Representing through digital models

Alongside traditional representations on the two-dimensional plane, computer tools offer a wide range of possibilities for the creation of 3D digital models that are functional for specific study and documentation needs (Mandelli & Velo, 2010). The elaboration of models starts, as is well known, from a 'geometric, metric and compositional' analysis of the object to be modelled and leads to different results depending on the type of data to be represented and the objectives of the work.

Some models focus on the accurate representation of the physical characteristics of a building and its details, others focus on the visualization of metric or structural data for analytical or design purposes, and still others - particularly those used for simulations and immersive visualizations - are characterized by being dynamic and interactive.

In the context of the documentation of disused industrial architectures, different digital 3D modelling techniques offer targeted approaches to represent their complexity and specificities at the same time. Of course, the three-dimensional modelling methodology can vary significantly depending on the case study and representation needs, achieving different outcomes depending on the choice of digital tools and modelling techniques used (Di Giacomo, 2018). Plans, sections and other 2D drawings of the manufact form the basic foundation for the realization of dimensionally accurate and true-to-life three-dimensional models, where orthogonal projection drawings act as a guide during the modelling process. On the contrary, conceptual models provide, as is well known, summary indications, although just as effective in terms of information, as for example in modelling the historical evolution of an manufact, which aims to document the transformations that have taken place over time.

In both cases, the reference is to Constructive Solid Geometry (CSG) (Foley, 1996), a modelling technique that, by means of specialized software, allows the creation of three-dimensional models using solids and basic geometric entities combined through a sequence of



Boolean operations. This technique underlies the operation of many Computer-Aided Design (CAD) software that use vector graphics to represent traditional 2D drawing objects. CAD software also uses B-Rep (Boundary Representation) approaches, where three-dimensional objects are represented using surfaces defined by their boundaries and borders. The CSG approach can be used to obtain different shapes, depending on the complexity of the manufact to be modelled and the precision required in its representation, also lending itself to incremental modelling to be carried out in successive stages, the final outcome depending on the precision with which the whole can be broken down into basic geometric shapes. The more detailed and accurate the primitives used and the operations performed, the closer the model comes to the constructed reality or the original idea.

For the modelling of organic or particularly complex shapes, the reference is to NURBS (Non-Uniform Rational B-Spline) processes that make use of methodologies focused on the representation of mathematical curves and surfaces defined by control points [3]. These models are distinguished by their ability to represent architectures that are compositionally characterized by irregular shapes, thus enabling the accurate replication of existing geometries, even in cases where the decomposition into simple solids is complex.

In order to render NURBS surfaces, we resort to transforming them into a polygonal model based on the representation of forms through polygons, each defined by a triad of coordinates that univocally represents a plane (the triangle) and whose ensemble constitutes, as is well known, a mesh. In this case, the curved surfaces are reduced to a sequence of planes, with the number of polygons increasing in proportion to the quality of the desired smoothing, while also increasing the digital weight of the model. Meshes are therefore based on a three-dimensional network of vertices, edges and faces that approximate the surface of objects, whatever their complexity. The overall characteristics of the model depend on topological information between the meshes.

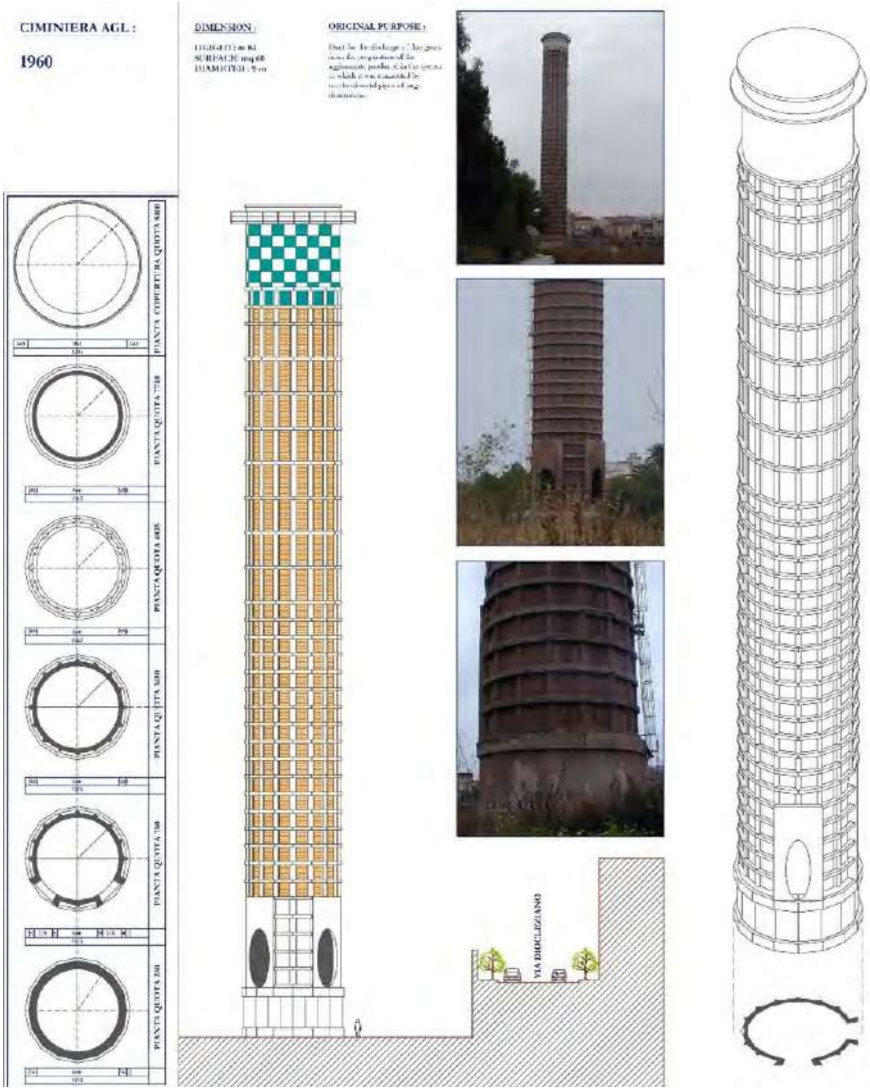


Fig. 4. Survey, graphic representation and 3D model of the disused chimney at Bagnoli, Naples (model by A. Mosca).

Parallel to modelling techniques that are based on decomposition processes, procedures capable of returning models from three-dimensional digital

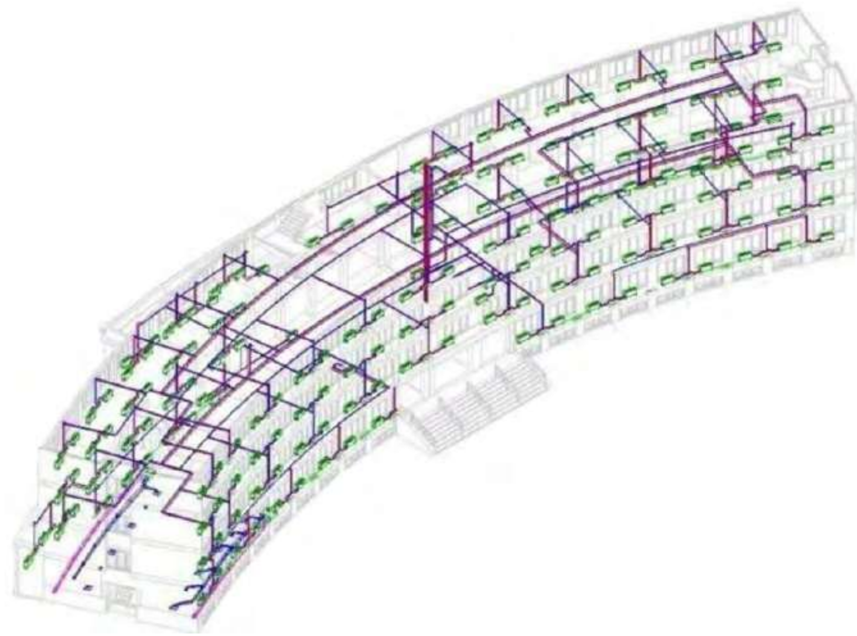


Fig. 5. 3D models can focus attention on a specific aspect such as the internal plant structure, dematerializing other features (Militar hospital in Agnano, model by M. Siconolfi).

survey acquisitions should be considered in this field of reflection. The reference is to reality-based models that derive from the use of LiDAR and digital photogrammetry technologies that allow the rapid creation of three-dimensional models based on metric data. LiDAR (Light Detection and Ranging) technology employs laser light to measure the distance between itself and points belonging to surrounding surfaces, making it possible to obtain point clouds, i.e. a large number of points of known coordinates, arranged in digital three-dimensional space and representing the surfaces of the acquired elements. These data can be processed to be transformed into mesh models so that the discontinuity of the points is transformed into the continuity of the actual surfaces, maintaining high levels of metric accuracy. Alongside this, digital photogrammetry uses photographic images and SfM (Structure for Motion) algorithms to replicate the shape and proportions of photographed objects. This process relies on photographic acquisitions from different viewpoints of homologous points to obtain 3D models from automated reverse perspective and stereoscopy procedures performed by specialized software. The software identifies common points between the images and calculates their position in digital three-dimensional space. The result is once again a dense point cloud representative of the photographed surfaces, from which mesh models can be generated.

The mesh models obtained from reality-based surveys are generally high-density, i.e. they are categorized as high poly (de Carlo, 2007) and are such that they perfectly replicate the course of real surfaces, regardless of their complexity, as long as they were framed by the sensor at the time of acquisition. It is also true that everything that is framed is replicated without any selection, regardless of utility. A true cast of reality (Russo & Guidi, 2010). This results in elements of the architecture appearing in continuity with extraneous elements, such as vegetation.

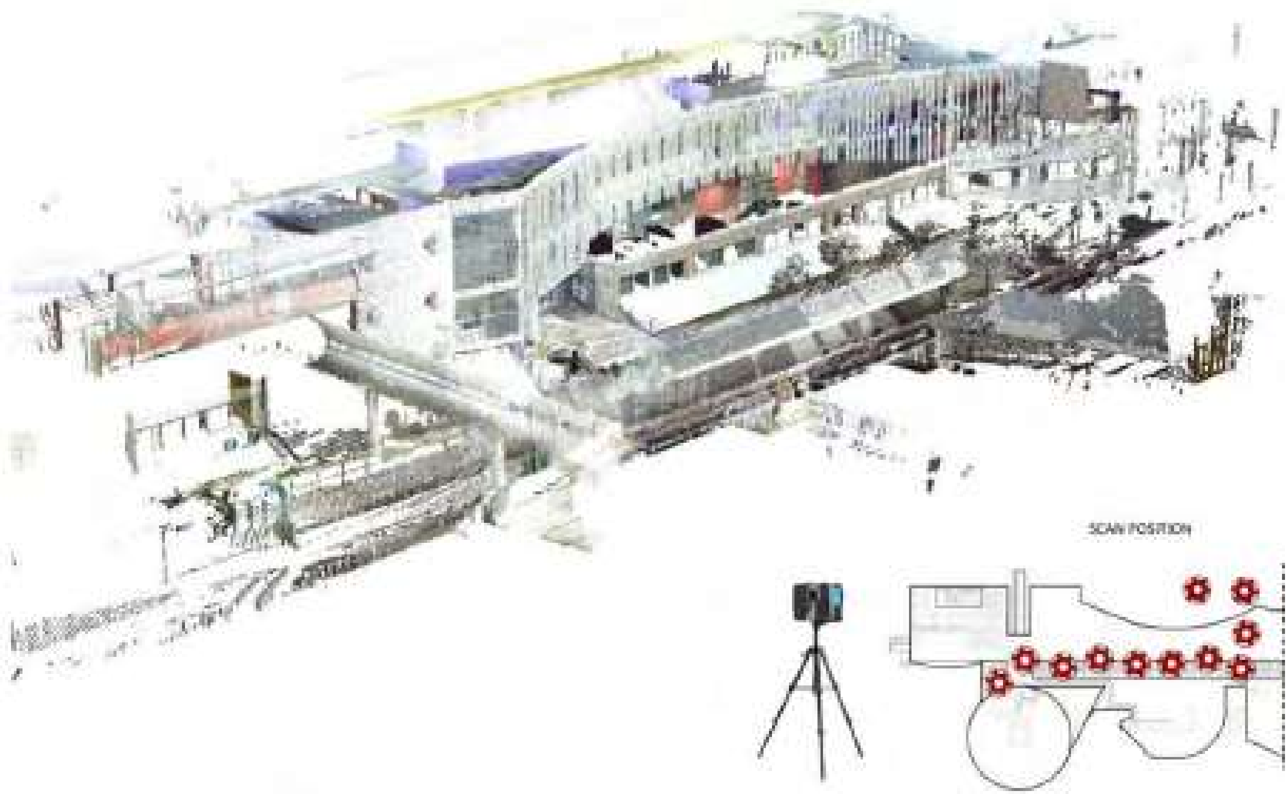
At the same time, this process appears particularly effective in the documentation of disused industrial buildings that are in a state of high decay and precarious security conditions, as the timeliness of the acquisition process and the possibility of mounting photographic sensors or lidar sensors even on aerial devices such as drones, makes it possible to metrically record and digitally explore even inaccessible areas. Both reality-based technologies offer an efficient and effective way to capture three-dimensional data and create digital models that accurately represent the geometry and dimensions of existing buildings.

Integrations, BIM and digital twin

The combined use of modelling techniques based on decomposition processes and reality-based data acquisition enables a complete and detailed understanding of three-dimensional objects and structures, thus contributing to the documentation and enhancement of architectural heritage. Over the years, protocols and guidelines have been developed for the integration, segmentation and interpretation of reality-based survey

data so that the geometric memory can be interpreted and completed with data equally indispensable to the understanding of an manufact, including a shared, multidisciplinary approach (Balzani & Maietti, 2017).
Building Information Modeling (BIM) is an integrated approach that enables the creation and management of three-dimensional digital models of building manufacts, incorporating detailed information relating to different aspects, from geometry, history, construction techniques, stratigraphy, etc.
The incorporation of different data derives from the principle that underlies the BIM process, which allows data and analyses of different types and formats to be incorporated within a single workspace, with a view to being able to build a digital twin of the real manufact. Digital twins therefore intend to replicate the state of the real manufact, starting from a semantic decomposition of the different components of the architecture and their relationships. Working in BIM as part of a process of knowledge, design and intervention on the built heritage means collecting and systemizing all the necessary information so that the decision-making process is supported and guided by a digital simulation of the outcomes of each operation.
BIM modelling represents an object-oriented approach, in which each component of the architecture takes on the role of a specific element in the model, endowed with unambiguous meaning and behaviour, both individually and in relation to the other elements.
The implementation of the BIM geometric model with data from different sources and with different formats allows the federation of models obtained through various modelling techniques and procedures. In fact, it has become common practice to build BIM models from point clouds, which serve as the basis for fitting and positioning parametric digital elements. Each element of the BIM model is characterized by a specific behaviour defined by the tool algorithm and compliance with domain standards and is parametric. This means that each distinguishing feature is determined by a specific parameter, the value of which is chosen

Fig. 6. The laser scanner point clouds allow us to navigate in 3D in a model that is perfectly metrically close to reality (University building in Monte Sant'Angelo. Survey by S. Scandurra, M. Pulcrano, M. Siconolfi).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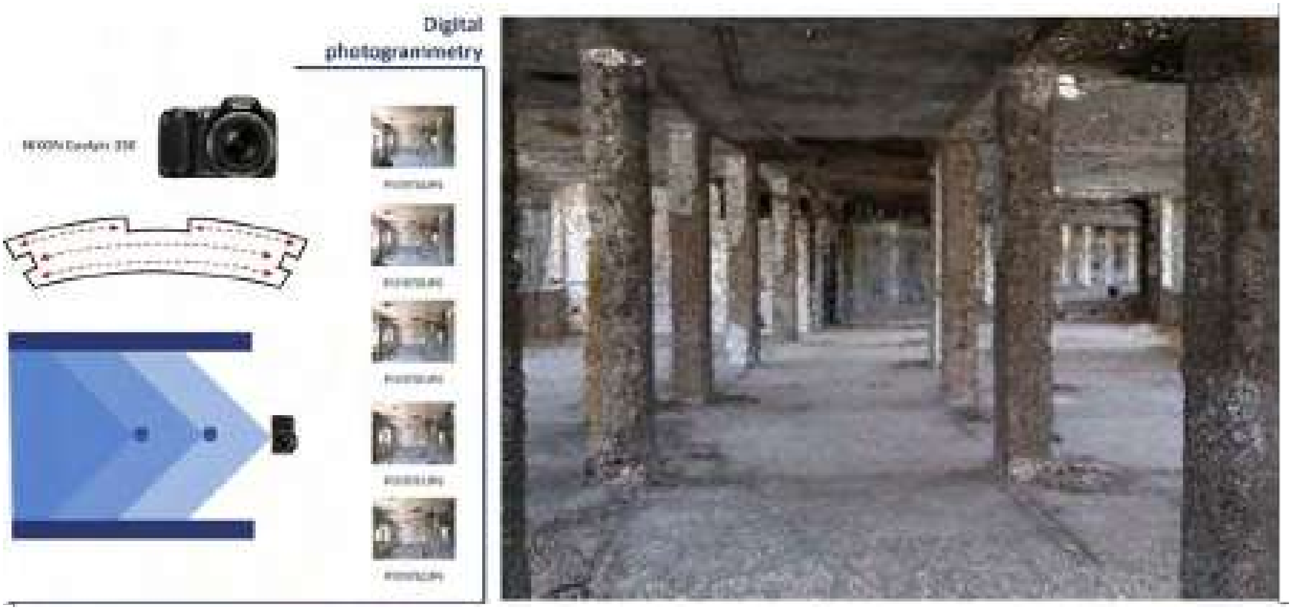


Fig. 7. Point clouds obtained from photogrammetric processes have the advantage of maintaining a high adherence to reality even from a photorealistic point of view (Militar hospital in Agnano, survey by M. Siconolfi and S. Monaco).

based on the specific properties of the manufact.
In other words, BIM modelling allows for the creation of a digital environment in which each architectural element is represented in a detailed and dynamic manner, enabling operators to visualize, analyze and modify the model at any time, verifying any interferences immediately.

Interoperability between different models

The vast choice offered by IT tools and the evolution of computer graphics means, as is well known, that there are considerably different data formats depending on the type of geometric (or non-geometric) information that can be recorded in them. Although in the BIM environment, models, representations and information from different formats and disciplines can be imported and read in superimposition, the need to export and transfer data remains. This need may depend

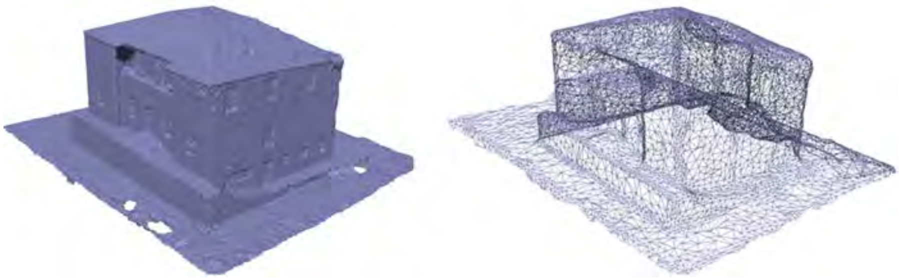


Fig. 8. Reality-based surveys can be transformed into meshes. In the figure, the mesh is displayed as a solid surface (left) and only with triangular mesh borders (right) (model by S. Scandurra).

on several factors. For example, importing into a different software may depend on the desire to carry out manipulations of the data that are impossible to achieve in native software; or it may be necessary to carry out technical analyses in performance simulation software; or it may be necessary to provide a reading of the model to operators who need to provide for the development of specific model components.

The identification and use of an interchange file format that is as neutral as possible (free from the constraints of a specific proprietary software house), ensures that the transfer of geometries and information keeps the native structure of the data firmly in place, avoiding losses.

It should be made clear here that an interchange format may be structured according to two types of translations of the native data, since the exchange output may be editable or only searchable. The choice depends on the purpose of the exchange but also on the level of compatibility possible between the language of the exporting software and the language of the importing software. In a sense, we could define each model as the combination of a "visual computer model" and a "data structure model". In exchanges where the model can be viewed, consulted, and queried - but does not allow modifications - we could consider only the visual computerized model as transferred. In exchanges where changes to geometry, data or specific properties are permitted, the data structure model is also exported and overwritten by the import software.

For 3D models, the most common open data format for exchanges is the

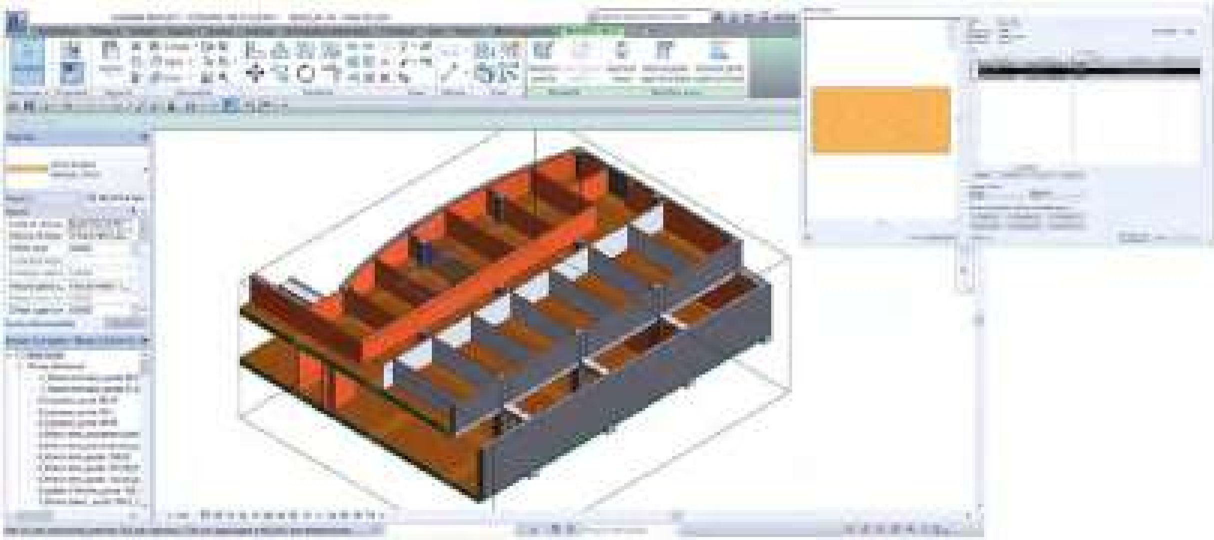


Fig. 9. A BIM model consists of elements that semantically replicate reality, adding relationships and detailed information at different scales (University building in Monte Sant'Angelo, model by F. Laviola).

OBJ format, which effectively allows export and import into software dedicated to even quite different modelling processes. For example, meshes obtained from point clouds can be exported and imported in OBJ, as can 3D CAD models, or NURBS. This is an exchange format that keeps the geometry and, possibly, the texturing unaltered and modifiable. In fact, this interchange format guarantees interoperability between different modelling software while retaining the graphical information of the native data, i.e. the position of each vertex, texture UV coordinates, normals and individual faces.

For point clouds, on the other hand, the exchange format that guarantees interoperability is either the .e57 format or the .xyz format, which record the colour and coordinates of the individual points in the cloud.

For BIM models, the OBJ format is not sufficient as it is deficient in the transfer of information data. In this case, the IFC exchange file format, which is still being continually updated, was prepared. The .ifc format guarantees the exchange of information and collaboration between the

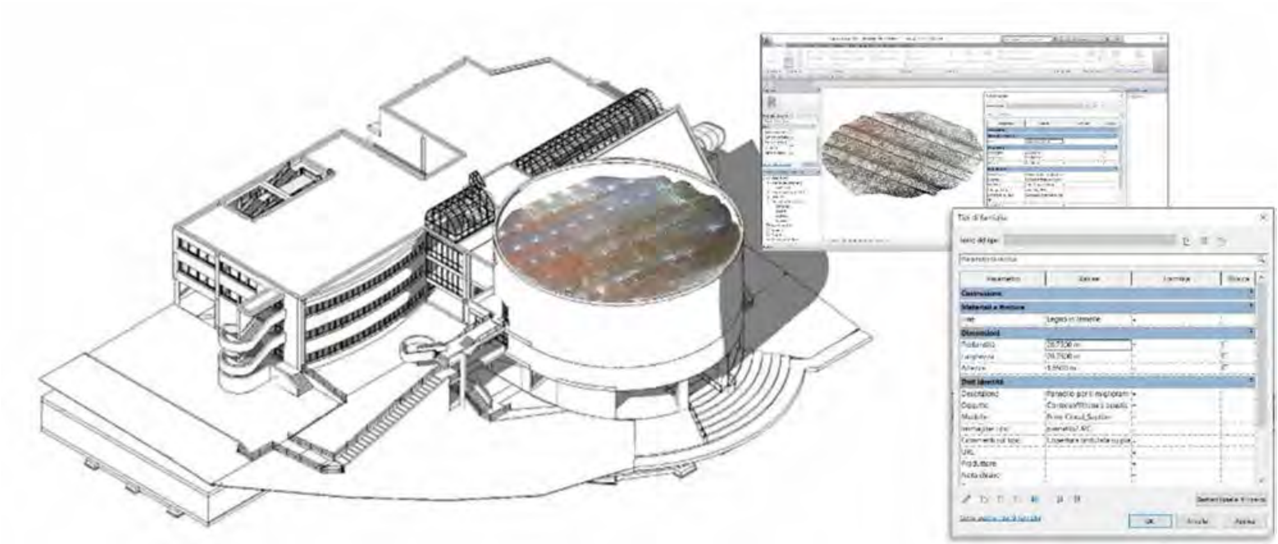


Fig. 10. Different types of models can provide unprecedented readings when integrated with each other. In the example in the figure, the point cloud model of some parts of the building were imported directly into the 3D BIM model (University building in Monte Sant'Angelo, model by M. Siconolfi and S. Scandurra).

different users of the BIM process, but also protects the intellectual property of each of the operators as it exports data that can be consulted but not modified, unless specifically indicated. In BIM interoperability, in fact, the purpose for which a model is exchanged, who is to receive it and how they are to use it, are indispensable information that must be established prior to its transfer, as each export may or may not allow for the consultation and presence of specific features (geometric and non-geometric) rather than others.

Conclusion

Using digital models based on reality-based data, advanced modelling techniques for the replication of complex geometries, semantically recognized BIM elements and databases enriched with numerical and textual information, it is possible to simulate the conformation and state of conservation of an asset from different points of view, to analyze specific aspects, to understand its evolution and potential, and to hypothesize and verify future scenarios. Each model in fact represents a visual prefiguration and a means of communication capable of conveying more information. Only the integration of different models can offer a complete and multidimensional approach to knowledge for the conservation and valorization of the built heritage and in particular the abandoned industrial heritage.

Notes

[1] Examples include the cases of the former Corradini industrial complex in San Giovanni a Teduccio, Italsider in the Bagnoli plain and Sofer in Pozzuoli.

[2] The study was carried out as part of a degree thesis entitled Aree industriali dismesse: il caso di Bagnoli. Tutor Prof. A. Baculo Giusti, co-tutor Prof. A. di Luggo, candidate A. Mosca, 2004.

[3] From the perspective of computer development, NURBS are extremely complex algorithms that enable the construction of curved surfaces in a continuous manner.

References

Balzani, M., & Maietti, F. (2017). Architectural Space in a Protocol for an Integrated 3D Survey aimed at the Documentation, Representation and Conservation of Cultural Heritage. In *Diségno*, No. 1, pp. 113-122.

De Carlo, L. (Ed.) (2007). *Informatica e fondamenti scientifici della rappresentazione*. Roma: Gangemi editore.

Di Giacomo, A. (2018). *Modelli di Architettura*. Roma: NeP edizioni Srls.

Foley, J. D. (1996). Constructive Solid Geometry. In *Computer Graphics: Principles and Practice*. Addison-Wesley Professional, pp. 557-558.

Mandelli, E., & Velo, U. (Eds.) (2010). *Il modello in Architettura. Cultura scientifica e rappresentazione*. Firenze: Alinea Editrice.

Russo, M., & Guidi, G. (2010). La modellazione digitale reality-based ed interpretativa per la valorizzazione del patrimonio culturale. In G. Amoruso, E. Bistagnino, F. Brevi, M. Cecconello, G. Guidi, G. Pierluisi, M. Rossi, M. Russo (Eds.). *La Ricerca nel Disegno di Design*, pp. 202-211. Segrate (Milano): Maggioli Editore.

Surveying inaccessible Industrial sites

Valeria Cera

On the relationship between survey and industrial archaeology. From conceptualization to formalization

The action of surveying, understood precipitously, as part of the broader process of knowledge it constitutes, as the operation of collecting, cataloging, and representing the material features of former industrial factories, has been from the very beginning included in the conceptual determination of "industrial archaeology."

Although the authorship of the term is still doubtful, the close relationship between the practice of surveying and the cognitive approach to industrial heritage is made explicit from the earliest theorizing of the new field of inquiry.

Undoubtedly, many scholars have succeeded and progressively grappled with a definition of what would become a true discipline, extending, from time to time, the time limits, and its field of interest.

With certainty, it is possible to say that the definition of "industrial archaeology" was born in the 1950s, perhaps at the suggestion of the Belgian historian Renè Evrard, who for the first time in 1950 juxtaposed the adjective "industrial" with the noun "archaeology" to argue for the need to safeguard the blast furnace and forge of the Forneau Saint Michel near the town of Saint Hubert, in the province of Luxembourg, recognizing its important value as a testimony to a productive past (Fig. 1). The most accomplished use of the term, however, is due to Englishman

Fig. 1. Interior of the Forneau Saint Michel industrial site in Luxembourg (source: https://www.fourneausaintmichel.be/les-musees).

Michael Rix, a Birmingham University professor who in 1955 mentioned "industrial archaeology" within an article entitled Industrial Archaeology, published in the journal The Amateur Historian. In the publication, Rix does not provide a true definition of the term but clearly begins by circumscribing the issue to which he refers, namely, the need to safeguard all evidence dating from the period of the Industrial Revolution present on British soil and in those years, corresponding to the post-World War II period, marked by a worrying state of neglect (Rix, 1967).
The theorization of industrial archaeology is, evidently, intimately connected with industrialization, its revolution, and its historical evolution. Therefore, the fact that England is the place where the subject of industrial archaeology was first attested, having been the origin of the Industrial Revolution and the country where this process spread most

widely with a breadth of movement that no other European country has achieved, seems extremely logical and automatic.
The end of World War II had led many European nations to engage in intensive reconstruction of bombed-out towns; at the same time, the conflict had caused a loss of heritage dating back to the period of the Industrial Revolution. In England, the post-World War II situation was exacerbated by the emergence of new and powerful players on the world industrial scene, which had resulted in a loss of centrality of British firms. Britain's manufacturing structure faced considerable problems of competitiveness and survival, so the 1950s marked a period of severe retreat for British industry in comparison with the glories of the past. The first nation in the world to experience widespread industrialization on a large scale, it now faced a massive and sudden industrial resignation, questioning how to manage a built heritage, as well as a historical and cultural one, of undoubted scale. It is therefore in this atmosphere that industrial archaeology was born, initially conceived as a kind of "national revolution," that is, a cultural operation aimed at the recovery and preservation of industrial testimonies as well as raising public awareness of the importance of such manufacturing buildings, which were considered to all intents and purposes monuments, symbols of English industrial supremacy, as well as points of interest for the territory, which were to be considered on a par with cathedrals and castles (Baggio, 2014). Rix's work, in fact, did not have a theoretical intent and was not concerned with theorizing a new discipline; on the contrary, it is connoted by the need to defend England's industrial heritage, preserving it from the unrestrained demolitions and destructions it was facing, manifesting a desire to recognize the monumental character of industrial buildings, a simulacrum of a culture and mentality of local populations, a memory of a certain phase of the past, as well as a strong presence inherent to the English territory and landscape.
Rix's words are echoed by the similar work of further scholars who show how, between the 1960s and the mid-1970s, the new field of investigation

of industrial archaeology was gaining momentum and was fueled by significant developments characterized by a strong commitment to heritage preservation. These included Kenneth Hudson, a journalist who from 1954 to 1966 had been the BBC's correspondent for industrial affairs in the West of England and, therefore, interested in the cultural significance of the industrial monument with respect to which he also reasoned about the relationship between the antiquity of an object and its worthiness to be safeguarded (Hudson, 1963); Angus Buchanan, who reinforced Hudson and Rix's positions (Buchanan, 1972); Neil Cossons, since 1971 director of the newly founded Ironbridge Gorge Museum, sensitive to the changes of those years and to the issue of cultural heritage preservation (Cossons, 1975); Edward Rodney Richey Green, editor of a major industrial archaeology series at David & Charles, also focused on emphasizing the importance of identifying the decommissioned industrial asset as a cultural asset through the concept of monument (Green, 1963).

In this sense, an important boost was given by the creation in 1959 of the Industrial Archaeology Research Committee, a body created for the purpose of cataloging and preserving industrial monuments and providing, precisely, an initial definition of "industrial monument." This, although it does not include objects divorced from their original context, reveals a confidence in and admiration for industrial elements whose new aesthetics are recognized. Manufacturing artifacts, consisting of out-of-scale architectures in which repetition and seriality of elements are distinctive features, are appreciated as symbols of a popular history and expressions of architectural making in which form reflects function.

Gradually, initiatives and actions for the protection of industrial heritage multiplied, originating from the desire to obviate an uncritical preservation of manufacturing buildings for which a priority selection followed by documentation and cataloging, primarily typological, was indicated. For this reason, The Journal of Industrial Archaeology was founded in 1963, and in 1965 the National Record of Industrial Monuments (NRIM)

was established, thus extending monument protection laws to industrial monuments as well. Again, in 1976 the Association for Industrial Archaeology (AIA) was established, and the Industrial Archaeology Review was published.
These were the years in which the discipline made its debut on the Italian scene and began to spread across the country, first in the literary sphere and then in the academic sphere, until it invested public and political opinion. The appearance of the term "industrial archaeology" in Italy is due to the essay Perspectives of Industrial Archaeology published in Nuova Antologia in 1976 and originated from the pen of Franco Borsi, director at the time of the Institute of History of Architecture at the University of Florence. In the essay, Borsi criticizes the Anglo-Saxon model by outlining an idea of industrial archaeology that is renewed and, above all, more adherent to the Italian reality, decidedly distinct and different from the English one (Nesti, 2005). First, Borsi redefines the adjective "industrial" from a temporal point of view, broadening the study of production remains to the period before the industrial revolution in the strict sense, anticipating it to the 16th century, that is, when the first technological solutions heralding the dominance of the factory system occurred. This consideration was, then, closely linked to the issues of Italian industrialization that were much slower than those of Great Britain because of the persistence of artisanal methods, which were widespread throughout the country. Secondly, the Italian professor broadens the field of attention of the discipline, which is now really beginning to consolidate as such. In fact, to the narrow interest that the British reserved for the single artifact, grasped only in relation to economic and technological history, Borsi contrasts a broader view that goes beyond the typological classification typical of the Anglo-Saxons to build more solid roots of investigation, with the introduction of a methodology and a historical and architectural study of productive buildings (Borsi, 1978).
From Borsi's activity, the Italian Society of Industrial Archaeology (SIAI) was born, under the presidency of Eugenio Battisti, in 1977, with the

organization of an International Congress of Studies [1] held in Milan on the occasion of the exhibition on the eighteenth-century community of silk spinners of Caserta "San Leucio: archaeology, history, project," as well as the Center for Industrial Archaeology Documentation and Research. Little by little, initiatives by individual scholars flourished, oriented toward becoming aware of the extent to which in all regions of Italy, albeit with significant differences, an industrial heritage was present and widespread, or rather exemplifications of a process of transformation of landscape and culture dominated by the factory that modified, at the same time, places and objects of working-class life. In Veneto, Giovanni L. Fontana with a 1979 conference paved the way for the valorization process of the workers' village and the old woolen mill in Schio (Fontana, 1985). In Tuscany, Ivan Tognarini makes the case for the importance of Tuscany's industrial steel heritage by taking examples from a series of initiatives spread in other contexts, national and otherwise (Tognarini, 1980). In Umbria, Renato Covino debates the deepening of the disciplinary scope of industrial archaeology and the chronological aspects of the new subject (Covino, 1980). In the Mezzogiorno, Gregorio Rubino brings to attention the peculiarities of southern sites related to steel production, encouraging the establishment of the Association for Industrial Archaeology in the Mezzogiorno and the publication of a Bulletin of the same name (Rubino, 1978). In addition, a series of anthological works enriched and deepened the terms of the question: Massimo and Antonello Negri drafted a volume aimed at defining the methodology through which to understand, read, conserve and enhance industrial monuments; Giancarlo Mainini, Giancarlo Rosa and Adolfo Sajeva gave to the presses for the types of La Nuova Italia, a volume focused on the conservation and reuse of the disused industrial heritage (Mainini et al., 1981). With the coming, then, of the 1980s, industrial archaeology is a recognized and widespread discipline both in academia and among the public, in Italy as in England as in the rest of Europe.
The process of awareness and subsequent reconnaissance of industrial

heritage triggered in the 1950s and established in the following thirty years will continue progressively until today, thanks to the increasingly consistent efforts made by associations and institutional bodies. These include, in addition to the aforementioned AIA, the best known: the Society for Industrial Archaeology (SIA), also born in Great Britain; the Italian SIAI now merged into the Associazione Italiana per il Patrimonio Archeologico Industriale Heritage (AIPAI) [2]; the French Comité d'information et de liaison pour l'archéologie, l'étude et la mise en valeur du patrimoine industriel (CILAC) [3]; the Swiss Association pour le Patrimoine Industriel (API) [4], the association for the Quebec region Association québécoise pour le patrimoine industriel (AQPI) [5], the Swedish Svenska Industriminnesföreningen (SIM) [6], the Portuguese Associação Portuguesa para o Património Industrial (APPI) [7].
There is no shortage of European and international initiatives, some of which originated as a coming together under an international profile of some of the societies mentioned earlier, including: The European Federation of Associations of Industrial and Technical Heritage (EFAITH) [8], a body founded in 1999 to bring together all European associations for the preservation of industrial heritage; The European Route of Industrial Heritage (ERIH) [9], founded in the same year and addressing the tourism aspects of industrial heritage; The International Committee for the Conservation of the Industrial Heritage (TICCIH) [10], a body founded in 1973 with an international character to promote the study of industrial archaeology and the protection and interpretation of industrial heritage. Since 2014, the TICCIH has cooperated with the ICOMOS International Council on Monuments and Sites for better conservation of industrial monuments.

Thanks to the progressive work of the scholars and institutions mentioned above, today the discipline of industrial archaeology is well defined in its being a science with a multidisciplinary value that involves architecture, sociology, urban planning, technology and art history. It, in fact, deals with the study of the evidence of industrial production in all its forms: machines, buildings, technologies, infrastructures, analyzing its impacts, economic and social consequences, relations with the urban fabric and with the transformations of human life and society. The definition of the discipline is not limited to include only tangible material heritage, but also a set of intangible elements such as forms of technical knowledge, modes of production, written and oral memory, and traditions. Thus it is that, to date, UNESCO also includes industrial heritage in its list, and in this case, there are about fifty states with at least one recognized and catalogued heritage. Among these, the United Kingdom undoubtedly has a primary role with no less than eleven industrial sites, including places with significant landscape values due precisely to their industrial or mining presence. Of all the sites on the list, mining sites are undoubtedly the most numerous; however, there is also no shortage of working-class towns and industrial landscapes (such as the example of Ivrea, a 20th-century Italian working-class town linked in its history to industrialist Adriano Olivetti)(Fig. 2), industrial sites linked to water and hydroelectric power serving industries such as textiles (this is the case of the 18th-century Vanvitellian aqueduct serving the silk factories of San Leucio and the Royal Palace of Caserta), individual factories and railways (Astrella).

Fig. 2. The 20th century industrial city of Ivrea, Italy (source: https://www.ivreacittaindustriale.it).

The numerous sites on the UNESCO list, from multiple countries, demonstrate the global value of the impact of the advent of industry on landscapes, territories and cultures and the need, therefore, to formulate actions to safeguard the industrial heritage, aimed not only at the sterile preservation of the envelope but extended to the knowledge of the know-how and technologies used, through the definition of a methodological approach that, on the basis of what has been expressed so far, clearly has in the architectural survey an important and pivotal phase of the cognitive process.

The survey for knowledge of disused industrial heritage. Operational and methodological reflections

Industrial archaeology arose, as demonstrated, from the emergency of providing for the defense and preservation of the now disused manufacturing areas threatened by post-World War II reconstruction and the loss of Britain's industrial supremacy. The main tool for dealing with the urgency and promoting, at the same time, an initial understanding of the industrial monument was the filing of surviving evidence, following a primarily empirical approach to the matter.

Michael Rix defined the subject as an activity of cataloguing, even, in some specific cases, preserving, and interpreting the sites and structures of the early industrial revolution; Angus Buchanan wrote of industrial archaeology as a field of study that is related to the research, surveying, recording, and, in some cases, preservation of industrial monuments; Edward Rodney Richey Green described it as the cataloguing and study of the remains of early industrialism, especially those attributable to the 18th and 19th centuries.

From the very beginning, therefore, the survey of industrial buildings was configured as the main tool of industrial archaeology, taking on the physiognomy of a census of manufacturing sites in order to quantify their consistency, spread and, consequently, cultural significance.

Numerous survey campaigns were thus prepared in various regions,

first in England and then throughout Europe, aimed at cataloguing and describing fully all manufacturing activities and their buildings, in order to relocate them in the coeval urban and landscape fabric.
Industrial sites were identified for each territory, and each building was described in its historical evolution, the technique of the activities that took place there, and its physical characteristics.
The study was conducted by employing the Standard Industrial Classification (SIC) to facilitate heritage cataloging i.e., by grouping buildings by manufacturing macrocategories, the number of which ranged from six to sixteen. In fact, Kenneth Hudson considered six categories based on materials and products: 1. Coal and metals, 2. Energy, 3. Textiles, ceramics and glass, breweries, and distilleries, 4. Railways, inland waterways, and roads, 5. Building materials, and 6. Farms. Ian L. Donnachie, on the other hand, expanded the number by increasing the categorization of manufacturing sectors to sixteen: 1. Power Sources & Prime Movers, 2. Agriculture & Rural Industry, 3. Mining & Quarrying, 4. Food Processing, 5. Chemicals & Associated Industries, 6. Metallurgy, 7. Engineering. 8. Textiles, 9. Leather & Leather Working, 10. Clothing & Footwear, 11. Bricks, Tiles, Pottery, Glass, etc., 12. Timber & Paper, 13. Other Manufacturing Industries, 14. Public Utilities, 15. Communications, 16. Other Features (including Housing) (Donnachie, 1969). Arthur Raisthick, then, proposed six categories based on manufacturing industries: 1. Metallic raw materials and industries based on them, 2. Non-metallic raw materials and industries based on them, 3. Organic raw materials and industries based on them, 4. Energy and fuel, 5. Transportation, and 6. Housing - buildings and structures (Raisthick, 1973).
Similar subdivisions were also taken up by Giancarlo Mainini, Giancarlo Rosa, and Adolfo Sajeva.
The juxtaposition of "archaeology" and "industrial" now appears crystal clear, which, on a first reading, may create some perplexity from both a temporal and an aesthetic point of view (Cerato, 2015). The apparent

aesthetic contradiction lies in the fact that "archaeology" means the study and analysis of artistic artifacts often having great aesthetic value, while "industrial" tends to refer to something in which aesthetics is not a peculiar and/or primary value. This contradiction is overcome by the recognition of value, first and foremost historical as well as architectural, of such industrial artifacts. From a temporal perspective, the contrast arises because one thinks of archaeology as a science that deals with the vestiges of the ancient world and thus with something related to the past, while one associates the term industrial with productive, technological and economic phenomena related to progress and thus to the future. Again, the knot is untied where the archaeological character of the new discipline lies precisely in this direct analysis of a material remnant and its classification, through survey. In addition, as debated in the previous section, the adjective "industrial" is related to the time limit within which to conduct research on physical remains.

The peculiarity and indispensability of an architectural survey for the knowledge of the disused industrial heritage is also confirmed in the statutes and various documents that, over the years, have been promoted to protect and safeguard this heritage. The Nizhny Tagil Charter for the Industrial Heritage, promoted on July 17, 2003, by the TICCIH, reiterates in its articles the importance of an informative collection and cataloguing action of industrial remains that passes through the representation of their metric components. In particular, it is recommended that each territory identify, register and protect its industrial sites by initiating survey campaigns of the different types of factories of which to create inventories, searchable and freely accessible to the public, concerning a complete record of the physical characteristics and conditions of the site. The same directions are reiterated in The Dublin Principles, Joint ICOMOS-TICCIH Principles for the Conservation of Industrial Heritage Sites, Structures, Areas and Landscapes, adopted on November 28, 2011, by the 17th ICOMOS General Assembly. The document

reiterates how essential research and documentation of industrial sites is to their identification and preservation, emphasizing an interdisciplinary approach to the issue, in which the metric dimensional survey of manufacturing evidence plays a central role.
Although confirmed in its relevance, the digitization of abandoned industrial heritage poses quite a few problems in its execution, having to deal with sites often connoted by complete inaccessibility or reduced accessibility, declined in various ways.
Indeed, for abandoned manufacturing buildings it is possible to consider various forms of inaccessibility or "complex" accessibility that inevitably condition the techniques and operational choices for data collection: (i) very substantial surface extension that requires considering expeditious methods of acquisition for documentation; (ii) contexts connoted by difficulty of access with large instrumentation due to the presence of physical barriers (often these are abandoned buildings that have been disused for decades where neglect, vegetation and collapses compromise entry and/or movement inside) and that require considering equipment suitable for collecting information that is easy to use and manageable; (iii) areas located in very difficult socio-cultural contexts from a security point of view (often squatted) for which inexpensive tools for documentary investigation need to be considered; (iv) sites characterized by deposits of material toxic to human health formerly used in the construction field (e.g., asbestos) that require the use of data recording solutions in which the presence of on-site operators is not expected (as with the case study covered by the BIP, the Corradini factory) (Fig. 3).

The range of methodological tools and processes for the digitization of the built heritage is now wider and more varied than ever before. Therefore, the selection of the most appropriate approaches to cope with the problems enunciated above is also possible and supported by the progressive technological advancement that is increasingly affecting the field of architectural surveying.

Fig. 3. Current conditions of the limited accessibility of the ex Corradini industrial factory in Naples (author's photo).

Undoubtedly, the image-based digitization technique is a widely established and effectively used reference for surveying contexts that are particularly extensive and/or difficult to acquire due to factors related to physical and/or social accessibility.

In particular, aerial digital photogrammetry has been employed for more than a decade for surveys of areas connoted by great extension, starting from urban contexts up to archaeological parks, and is well suited, therefore, to applications also in the field of dismissed industrial heritage (Barba et al., 2019; Calisi et al., 2023; Mishra et al., 2024; Nandakishore & Kumar 2024; Saleri et al., 2013). The possibility of employing 'Unmanned Aerial Vehicle' UAVs effectively addresses the need to cover large portions of the territory in a short time, while at the same time making it possible to record sufficiently detailed information according to the parameters of calculating flight altitude, navigation speed, sensor resolution, and resulting GSD 'Ground Sample Distance' value (Six et al., 2024). Contextually, especially in cases of ELOS 'Extended Visual Line Of Sight' or even BVLOS 'Beyond Visual Line Of Sight' piloting, this technique allows for digitization of "complex" areas where it is preferable to avoid the presence of operators in the scene and, if anything, to consider their presence only close to it.

In the field of photogrammetry, then, particularly useful for contexts connoted by difficulties of access with large instrumentation due to the presence of physical barriers or difficult socio-cultural situations from the point of view of security, is the use of panoramic cameras i.e., spherical photogrammetry. Being low-cost, handy, and portable instruments, this type of photographic sensors lends itself well to surveying complexes, such as abandoned industrial complexes, where it is often difficult to access some environments with bulky instrumentation due to collapses or haunting vegetation, or where the presence of individuals squatting in the spaces compromises the safety of the operators. In this sense, in recent years several studies have been conducted on the validity of applying panoramic imagery and/or video for survey declined at different scales, from urban to architectural to archaeological complexes (Abate et al., 2017; Barazzetti et al., 2022; Cera & Campi, 2022; Herban et al., 2022; Mandelli et al. 2017; Zhao, 2021). Undoubtedly, great impulse in this direction is provided by a mixture of factors: (i) the availability on the market of high-resolution but low-cost panoramic cameras such as Matterport, Insta, GoPro; (ii) the marketing of SfM-type 'Structure from Motion' software for 3D modeling such as Agisoft Metashape, Pix4Dmapper, 3DFZephyr, which can easily support various models of spherical cameras without requiring prior calibration; (ii) the development and sale of extremely simple and friendly smart phone and web applications, e.g., Matterport Capture, which, starting from photographic shots taken with spherical cameras or with one's own cell phone, are able through Artificial Intelligence algorithms, to align and combine such photographic shots by processing a 3D model in the form of a textured mesh (Ingnam et al. , 2020; Shults et al., 2019).

Certainly, as is well known, the accuracy and precision achievable with passive-type optical sensors remain slightly lower than those achievable with active-type optical sensors. The use of range-based techniques for

surveying abandoned production contexts is, clearly, possible and not to be ruled out, although it must confront the limitations of accessibility discussed so far. In this framework, it is possible to state that the most appropriate instrumentation for the digitization of poorly accessible sites is the dynamic type, i.e., LIDAR 'Light Detection and Ranging' sensors that, integrated with SLAM 'Simultaneous localization and mapping' algorithms, are capable of discretizing the space being investigated in the form of a point cloud which, in real time, is determined during the movement (e.g., a walk) of the operator (Bailey & Durrant-Whyte, 2006; Di Stefano et al., 2021; Karam et al., 2019). The main advantage of a SLAM survey lies in the significant contraction of acquisition time, which is extremely useful in the case of very large areas and/or located in scenarios of difficult permanence such as for industrial archaeology. The speed of data collection operations is extremely balanced and commensurate with the accuracy of the recorded information therefore, if the survey understood as a campaign phase is characterized by a speed of execution, the quality of the collected data remains high and aligned with that of active sensors employed in static mode, such as the classic TLS 'Terrestrial Laser Scanner'. The latter, while remaining to date the most accurate tool capable of collecting precise information, proves difficult to employ in complex scenarios such as those specifying decommissioned industrial buildings, both because of the bulkiness of the instrumentation and the stationary mode of acquisitions, which is not very compatible with the precariousness, social and environmental, of the sites under consideration.
An interesting advance in the field of dynamic range-based sensor acquisition is represented by some experiments on the use of robots for architectural surveying, now increasingly popular thanks to the commercialization of agents such as Boston Dynamics' Spot (Fig. 4). These are applications in which, instead of terrestrial 3D laser scanners, mobile LiDAR and photogrammetric images acquired from unmanned aerial vehicles, autonomous robotic agents, almost always biomimetic and

quadrupedal, are used, on which ad hoc sensors, such as LIDARs and cameras, are installed, associated with simultaneous mapping algorithms. Therefore, these autonomous robotic agents are capable of performing the 3D reality modeling process with a systematic and repeatable approach, replacing the physical operator, whose presence is therefore superseded. Based on these considerations, the application potential of mobile robots in architecture and, specifically, in those scenarios in which it is not possible for the surveyor to be present at the scene due to safety issues becomes evident. If, in fact, mobile robots were initially used in difficult situations, such as environmental inspections, home maintenance, forestry and agriculture, and the exploration of inaccessible terrain such as volcano craters; today, another innovative application may be in the analysis and survey of architecture that requires mobile robots to perform difficult tasks in environments with limited human supervision (Cigola et al., 2017; Giakoumidis & Anagnostopoulos, 2024).

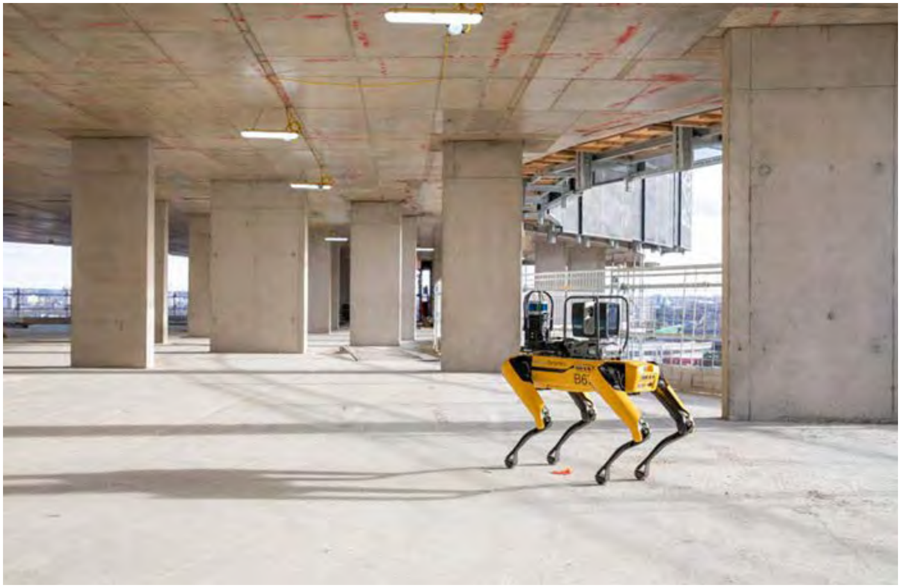


Fig. 4. Use for three-dimensional surveying of Boston Dynamics' "Spot" robot employed by Foster + Partners (source: https://www.dezeen.com/2020/11/13/foster-partners-adopts-spot-the-boston-dynamics-robot-dog/).

A final consideration in reference to the possibility of acquiring three-dimensional data by limiting the human presence on site is related to the wide dissemination and availability of open data that, properly processed in appropriate software, return digital models of selected areas (Borisov et al., 2022; La Russa, 2023). One example is the Autodesk Infraworks software, one of several solutions available today for 3D City Modelling, capable through its Model Builder, of reconstructing digital models from the import of a body of information available in open source (Fig. 5). Specifically, the open databases that are exploitable for this purpose are (i) for terrain orography, SRTMGL1, Nasa's Shuttle Radar Topography Mission; (ii) for buildings, highway, and railway, OpenStreetMap; and (iii) for raster imagery applied to DEM, Microsoft Bing Maps satellite imagery (Badenko et al., 2019; Campi et al., 2022).
Similarly, it is now possible to directly employ the three-dimensional data embedded in Google Earth by exploiting a frame debugger such

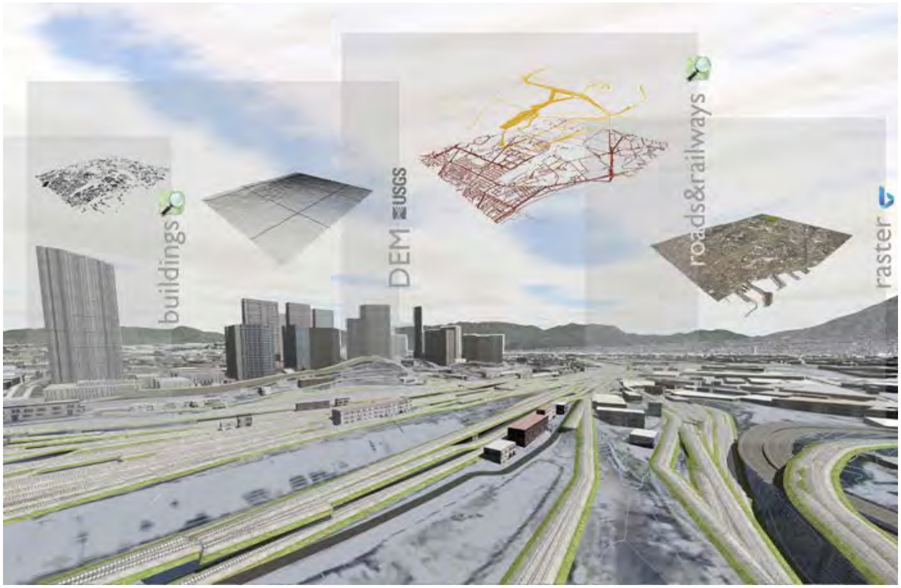


Fig. 5. Example of open data that can be used to produce a digital model in Autodesk Infraworks (image by the author).

as, for example, RenderDoc developed by MIT. Frames captured via the debugger in Google Earth, can be recomposed in Blender software via a special add-on, into a textured polygonal model, to which geographic coordinates similarly obtained from the Google database can also be associated (Stendardo et al., 2022).
In accordance with what has been discussed so far, it is possible to conclude that the issue of the survey of disused industrial sites represents a neuralgic point in the process of knowledge and analysis aimed at the formulation of protection, recovery, and preservation actions. Undoubtedly, the instrumental solutions and methodological processes formulated today make it possible to approach the digitization of these, often inaccessible, contexts with a possible and variously declined data collection project, depending on the type and level of accessibility. It is understood that the discriminating factor will be the level of accuracy and precision of the information recorded which, no less, responds regardless fully to that action of cataloging and census that since the historical definition of "industrial archaeology" has connoted and distinguished the new discipline.

Notes

[1] *Archeologia Industriale. Atti del convegno internazionale di studi*, Milano 24-26 giugno 1977, Milano, Clup, 1978.

[2] https://www.aipaipatrimonioindustriale.com/. L'AIPAI ebbe i suoi prodromi nella SIAI fondata da Eugenio Battisti con sede a Milano, a cui confluì anche l'Associazione per l'Archeologia Industriale Centro di documentazione e ricerca per il Mezzogiorno, nata nello stesso anno ma con sede a Napoli.

[3] http://www.cilac.com/le-cilac-l-association/qui-sommes-nous.html.

[4] https://www.patrimoineindustriel.ch/.

[5] http://www.aqpi.qc.ca/.

[6] http://www.sim.se/about-SIM.

[7] http://www.museudaindustriatextil.org/appi/links.php.

[8] http://www.e-faith.org/.

[9] https://erih.net/.

[10] https://ticcih.org/.

References

Abate, D., Toschi, I., Sturdy-Colls, C., & Remondino, F. (2017). A low-cost panoramic camera for the 3d documentation of contaminated crime scenes. In *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences,* Vol. XLII-2/W8, pp. 1-8.

Astrella, C. I. Industrial Archaeology. A Historical Outline. Compasses C38. <https://compassesworld.com/premium-lunghi/industrial-archaeology-a-historical-outline/> (accessed 30 April 2024).

Badenko, V., Zotov, D., Muromtseva, N., Volkova, Y., & Chernov, P. (2019). Comparison of software for Airborne Laser Scanning data processing in Smart City applications. In *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XLII-5/W2, pp. 9-13.

Baggio, P. M. (2014). *Dall'archeologia industriale al turismo industriale. Il caso dell'alto vicentino*. Bachelor's thesis in Sviluppo interculturale dei sistemi turistici. Supervisor Prof. F. Cavallo. University Ca' Foscari Venezia (Italy).

Bailey, T., & Durrant-Whyte, H. (2006). Simultaneous localization and mapping (slam): Part ii. In *IEEE robotics & automation magazine*, Vol. 13, No. 3, pp. 108-17.

Barazzetti, L., Previtali, M., & Ronconi, F. (2022). 3D modeling with 5K 360° videos. In *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XLVI-2/W1-2022, pp. 65-71.

Barba, S., Barbarella, M., Di Benedetto, A., Fiani, M., Gujski, L., & Limongiello, M. (2019). Accuracy Assessment of 3D Photogrammetric Models from an Unmanned Aerial Vehicle. In *Drones*, Vol. 3, No. 4, p. 79.

Borisov, M., Radulović, V., Ilić, Z., Petrović, V.M., & Rakićević, N. (2022). An Automated Process of Creating 3D City Model for Monitoring Urban Infrastructures. In J*ournal of Geographical Research*, Vol. 5, No. 2, pp. 1-11.

Borsi, F. (1978). *Introduzione all'archeologia industriale*. Roma: Officina.

Buchanan, A. (1972). *Industrial Archaeology in Britain*. London: Penguin Books Ltd.

Calisi, D., Botta, S., & Cannata, A. (2023). Integrated Surveying, from Laser Scanning to UAV Systems, for Detailed Documentation of Architectural and Archeological Heritage. In *Drones*, Vol. 7, No. 9, p. 568.

Campi, M., Cera, V., Falcone, M., & Ferrara, M. (2022). La rappresentazione del territorio peri-urbano tra city modelling, rilievo e fotografia. In C. Battini, E. Bistagnino (Eds). *Dialoghi. Visioni e visualità. Testimoniare Comunicare Sperimentare*. Atti del 43° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione, pp. 2165-2185. Milano: Franco Angeli.

Cera, V., & Campi, M. (2022). Fast survey procedures in urban scenarios: some tests with 360° camera. In *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XLVIII-2/W1-2022, pp. 45-50.

Cerato, S. (2015). *Il progetto urbano secondo un approccio multidisciplinare: analisi e rifunzionalizzazione dell'area di un manufatto industriale lungo la Riviera del Brenta*. Bachelor's thesis. Supervisor Prof. A. Giordano, co-supervisors Proff. S. Zaggia, L. Stendardo. University of Padua (Italy).

Cigola, M., Gallozzi, A., Senatore, L. J., & Di Maccio, R. (2017). The HeritageBot Project. Putting Robotics into Survey. In M. Ceccarelli, M. Cigola, G. Recinto (Eds.). *New Activities for Cultural Heritage*, pp. 113-121. Springer International Publishing.

Cossons, N. (1965). *The BP book of Industrial Archaeology*. Newton Abbot: David & Charles.

Covino, R. (1980). Archeologia industriale in Italia: ambito disciplinare, termini cronologici. In *Quaderni Storici*, Vol. XV.

Di Stefano, F., Torresani, A., Farella, E. M., Pierdicca, R., Menna, F., & Remondino, F. (2021). 3D surveying of underground built heritage: Opportunities and challenges of mobile technologies. In *Sustainability*, Vol. 13, No. 23, p. 13289.

Donnachie, I. L. (1969). Aids to recording (I). The classification of industrial monuments. In *The Journal of the Industrial Archaeology*, Vol. 6, No. 1, p. 52.

Fontana, G. L. (1985). *Schio e Alessandro Rossi: politica, cultura e paesaggi sociali del secondo Ottocento*. Roma: Edizioni di Storia e Lettaratura.

Giakoumidis, N., & Anagnostopoulos, C. (2024). Autonomous Reality Modelling for Cultural Heritage Sites employing cooperative quadrupedal robots and unmanned aerial vehicles. In *ArXiv*, abs/2402.12794.

Green, E. R.R. (1963). *The Industrial Archaeology of County Down*. London: Belfast H.M. Stationery Office.

Herban, S., Costantino, D., Alfio, V. S., &Pepe, M., (2022). Use of Low-Cost Spherical

Cameras for the Digitisation of Cultural Heritage Structures into 3D Point Clouds. In *Journal of Imaging*, Vol. 8, No. 1, p. 13.

Hudson, K. (1963). *Industrial Archaeology, an introduction*. London: Routledge.

Ingman, M., Virtanen, J.-P., Vaaja, M.T., & Hyyppä, H. (2020). A comparison of Low-Cost sensor systems in automatic cloud-based indoor 3D Modeling. In *Remote Sensing,* No. 12, p. 2624.

Karam, S., Vosselman, G., Peter, M., Hosseinyalamdary, S., & Lehtola, V. (2019). Design, calibration, and evaluation of a backpack indoor mobile mapping system. In *Remote sensing*, Vol. 11, No. 8, p. 905.

La Russa, F. M. (2023). A Proposal for a Parametric 3D City Model Semantic Format. In *Nexus Netw J,* No. 25 (Suppl 1), pp. 481-489.

Mainini, G., Rosa, G., & Sajeva, A. (1981). *Archeologia industriale*. Firenze: La Nuova Italia.

Mandelli, A., Fassi, F., Perfetti, L., & Polari, C. (2017). Testing different survey techniques to model architectonic narrow spaces. In *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XLII-2/W5, pp. 505-511.

Mishra, A., Kumar Agnihotri, A., Pipil, S., Gaur, S., & Ohri, A. (2024). Surveying techniques for urban areas. In A. Kumar, P. K. Srivastava, P. Saikia, R. Kumar Mall (Eds). *Earth Observation in Urban Monitoring: Techniques and Challenges*, pp. 69-91. Elsevier.

Nandakishore, S. S., & Kumar, A. (2024). Advanced Application of Unmanned Aerial Vehicle (UAV) for Rapid Surveying and Mapping: A Case Study from Maharashtra, India. In S. Ghosh, M. Kumari, V. N. Mishra (Eds). *Geospatial Technology to Support Communities and Policy. Geotechnologies and the Environment*, Vol 26, pp. 185-202. Springer, Cham.

Nesti, A. (2005). L' archeologia industriale in Italia tra storia dell'architettura e storia economica. In *Storia Economica*, Vol. VIII, No. 1, pp. 247-257.

Raisthick, A. (1973). *Industrial Archeaology. An Historical Survey*. Frogmore: Paladin.

Rix, M. (1967). *Industrial Archaeology*. London: Historical Association.

Rubino, G. E. (1978). *Archeologia industriale e Mezzogiorno. Problemi di architettura degli impianti, tecnologia, società*. Roma: Giuditta Editore.

Saleri, R., Cappellini, V., Nony, N., De Luca, L., Pierrot-Deseilligny, M., Bardiere, E., & Campi, M. (2013). UAV photogrammetry for archaeological survey: The Theaters area of Pompeii. In *Digital Heritage International Congress (DigitalHeritage)*. Conference proceedings. Marseille, France, 28 October - 1 November 2013, Vol. 2, pp. 497-502. Institute of Electrical and Electronics Engineers.

Stendardo, L., Spera, R., Campi, M., Cera, V., & di Luggo, A. (2022). Urban design strategies for the upcycling of urban infrastructure residual pockets: 3D City Modelling from Open Data and low-cost rapid mapping tools. In *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XLVIII-3/W2-2022, pp. 59-65.

Shults, R., Levin, E., Habibi, R., Shenoy, S., Honcheruk, O., Hart, T., & An, Z. (2019). Capability of matterport 3d camera for industrial archaeology sites inventory. In *The International Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. 42(2/W11), pp. 1059-1064.

Six, Y., Barreau, J.-B., & Giligny, F. (2024). 3D modeling, surveys and reconstruction of the Varenne forges. In *Digital Applications in Archaeology and Cultural Heritage*, Vol. 32, p. e00306.

Tognarini, I. (1980). L'archeologia industriale 'édifice encore naissante': alcuni contribuiti francesi. In *Ricerche Storiche*, Vol. X.

Zhao, C. (2021). *Creating point clouds, textured meshed models and orthophotos with Weiss AG Civetta - 230 megapixels 360°HDR camera*. <https://docplayer.net/209971609-Civetta-agisoft-metashape.html> (accessed 30 April 2024).

Industrial Heritage.
A methodology for digital photogrammetry and digital survey

David Marcos Gonzales, Víctor Lafuente Sanchez

Introduction

Industrial heritage is a vital testimony to the era of industrial exploitation, encompassing a wide range of immovable, movable and intangible assets. These include sawmills, fulling mills, wineries, lime kilns, shearing mills, forges and racks, wine presses, wool washers, fishing factories, weavers, optical telegraphs, plastering plants, mills, water mills, flour factories, tanning factories, blacksmith shops, or even homes and the social infrastructure related to those industries (del Pozo et al., 2008). In Spain, the recognition and conservation of this heritage began to take shape in the 1980s, culminating in the creation of the National Industrial Heritage Plan between 2001 and 2002. This plan focuses on cataloguing, protecting, and promoting these assets, although currently in Spain there are a large number that still stand to be studied and consolidated.

Industrial heritage can play a crucial role in promoting sustainability, as highlighted in the United Nations, Sustainable Development Goals, where the importance of sustainable cities and communities is emphasized [1]. The adaptive reuse of historic industrial structures, for example, can offer innovative solutions for housing, commerce, and public spaces, contributing to urban resilience and sustainable development. In this sense, projects such as the San Antonio flour factory in Medina de Rioseco, the steel museum in Sabero, the Olivares' mills in Zamora or the rehabilitation of silos in Spain (Fig. 1) are examples of how industrial heritage can be transformed and reintegrated into the contemporary

Fig. 1. From left to right: San Antonio flour factory in Medina de Rioseco (Valladolid); Sabero steel industry museum (León); Olivares mills (Zamora (images: Architectural Photogrammetry Laboratory, Valladolid).

fabric of cities, maintaining its historical essence while adapting to new functions. The importance of safeguarding this heritage goes beyond mere conservation; it is a matter of recognizing and valuing the heritage received from the industrial age and understanding how it has shaped contemporary society.

Architectural restoration is a discipline that combines art, science and history, and is essential to preserve the cultural legacy of our society. Before intervening in a historic building, it is essential to carry out exhaustive research that includes the study of ancient documents, structural analyzes and evaluations of its state of conservation. This process allows restorers to understand not only the building's physical history and original construction techniques, but also previous interventions and their impact on current structural integrity. With all this knowledge, professionals can plan a respectful intervention that preserves the essence of the heritage, while ensuring its safety and functionality for future generations. Careful and knowledgeable restoration ensures that historic buildings remain living witnesses to our past, while remaining an active part of the present community.

This is what Luis Cervera Vera (1984) was referring to in his work with the term anatomy of the building where the collection of data from the building and its critical analysis allowed him to break down the construction stages and the elements that were part of an architecture in each moment, synthesizing the result in graphic representations of the different formal configurations, which reflected a return in time, eliminating successive additions over the course of the building's life. A thorough understanding of this architectural heritage requires comprehensive documentation covering both the building and its surroundings.

To achieve this, advanced 3D digitization tools will be used, such as photogrammetry (terrestrial and aerial) and laser scanning, which allow physical reality to be captured with extraordinary precision and detail. Photogrammetry uses photographic images to create 3D models, taking advantage of the parallax between photos taken from different points of view. On the other hand, laser scanning is based on the emission of a beam of light that, when incident on surfaces, allows distances to be measured and thus generates an accurate three-dimensional point cloud representation of the scanned object.

These techniques not only facilitate heritage conservation, but also provide a solid basis for any future interventions, allowing experts to analyze and plan with a complete view of the current state of the cultural property. Furthermore, 3D digitization opens the door to the possibility of sharing this heritage with the world, either through immersive experiences in virtual reality or by reproducing exact replicas with 3D printing.

With the implementation of these technologies, it is ensured that the historical and cultural richness of the buildings is not only preserved, but also enhanced and made accessible for future generations. The accuracy and richness of data these tools provide are critical to fully understanding the magnitude and importance of heritage sites, ensuring that every detail, from the texture of materials to the subtleties of architecture, is accurately captured and documented in the greatest possible fidelity.

Documentation Methodology

To the data collecting, the use of two tools is proposed that can be used independently or can be combined, resulting in a much more complete model; these are the laser scanner and photogrammetry. In both cases, the result will be a digital twin of the real object that will accurately show the geometric and colour state at the time of being documented.

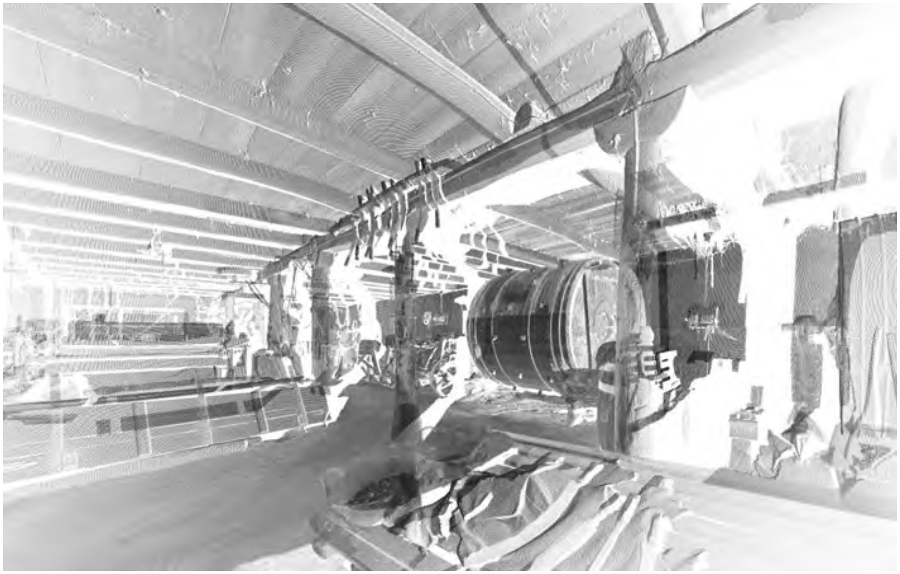


Fig. 2. 3D visualization of a single point cloud obtained using a laser scanner from the Santa María del Páramo tanning factory (León) (image: Architectural Photogrammetry Laboratory, Valladolid).

Laser scanner

A three-dimensional laser scanner is based on lidar technology, from the English acronym LiDAR [2] (*Light Detection and Ranging o Laser Imaging Detection and Ranging*); it is a device that allows to determine the distance from an object or surface to the emitter using a beam of laser pulses [3], and combined with the camera they incorporate (in the first scanners it was an external element) they also manage to capture visible range information (color).

These devices have been evolving both from a formal and functional point of view, since at the beginning they were large devices with a significant but not excessive weight, which also required the need for many auxiliary elements for their operation (external batteries, cables, computers, cameras, etc.). Today they are smaller, lighter, faster and are capable of capturing a greater number of points per second.

At the same time, they are incorporating multiple camera systems around the perimeter of the scanner housing that allow colour to be captured

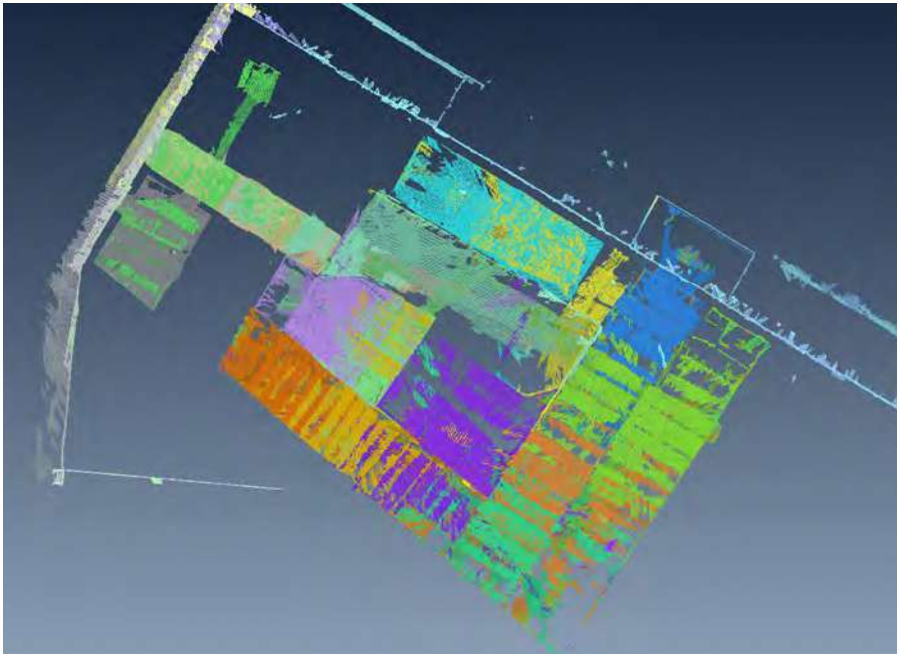


Fig. 3. Process of aligning several scans with each other to obtain a point cloud of the set. Santa María del Páramo tanning factory (León) (image: Architectural Photogrammetry Laboratory, Valladolid).

with HDR images in less time; and also, during movement between parking lots, these cameras perform continuous tracking during the data collection process, which allows them to automatically pre-register the scans.

They are devices that contain extensive measurement technology, positioning, inertial systems, etc., inside. The distance to the object is determined by measuring the time elapsed between the emission of the pulse and its reception through the reflected signal. With the measurement made on the object or surface, it is able to capture the geometry and color with millimeter precision. To do this, it performs a laser scan of the building or object that we are studying, obtaining a metric point cloud of the geometry (Fig. 2). This point cloud [4] is raw, that is, the data capture is not selective, but rather it is a massive data collection in which it does not discriminate any of the points; it captures information about

Fig. 4. Process of obtaining detailed documentation from a point cloud model. San Antonio flour factory in Medina de Rioseco (Valladolid) (image: Architectural Photogrammetry Laboratory, Valladolid).

everything in the device's environment. This classification or selection of points is something that the technician will have to do later, when evaluating the data and performing the registration or alignment between the different scans (Fig. 3).

In short, the laser scanner has great potential, allowing all objects or surfaces surrounding the device to be recorded in a limited radius in a matter of minutes and without the need for contact with the measured objects.

The data obtained from the scanner is a collection of points oriented with reference to a system centered on the origin of the scanner's coordinates, information to which is eventually also added the color of the object, or even some other data related to its physical aspects.

The documentation obtained by the scanner provides the generation of three-dimensional full-scale point cloud models of the building object of the survey which, after subsequent processing, will lead us to generate sufficient documentation (Fig. 4) for the evaluation of the building.

Laser scanners, due to the way they are positioned when performing scans, can be divided into two categories: static and dynamic.

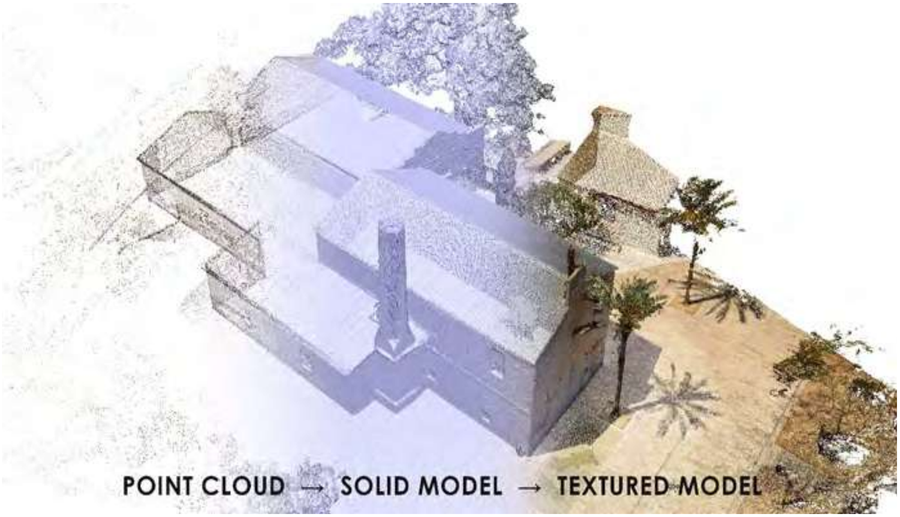
- <u>Static</u> are those scanners that remain in a fixed position during data collection; it is the most used method when performing terrestrial scans. The advantage of this method is its high precision.

- <u>Dynamic</u> are those scanners that are mounted on a mobile platform, such as a vehicle, train, ship, plane, unmanned aerial platforms or personal backpacks; these systems are also known as Mobile Mapping. Because the device is constantly moving, these systems require other additional positioning devices such as Inertial Navigation Systems (INS) or Global Positioning Systems (GPS), which makes the complete system more expensive and complex.

The most important advantages of using a laser scanner in survey and documentation projects are:

- Medidas. 3D scanning is a technological revolution in the field of measurement and modelling. It allows to capture the physical form of objects and spaces with millimetre precision, transforming them into detailed digital models. This technology is invaluable to architects, engineers, and construction professionals as it makes it easier to detect discrepancies between the planned design and the current structure, thus optimizing the construction and maintenance process (Vacca et al., 2016).
- Security. 3D scanners have revolutionized the way measurements can be obtained from dangerous or hard-to-reach spaces. These devices, thanks to their ability to take data remotely, allow operators to perform complete and fast measurements without compromising their safety. This technology is especially valuable in industries such as mining, construction, and archaeology, where on-site risks can be significant. By using 3D scanners, not only personnel safety is improved, but also the efficiency and accuracy of the data collected, allowing for better planning and decision-making based on detailed and reliable information (Marcos et al., 2016).
- Non intrusive (Garcia Fernandez et al., 2013). To collect data, it is not necessary to make stops of operators or works, nor does it interfere with the work times. Furthermore, as it is a device that works remotely, it is not necessary to get into a space as long as it is possible to do so from a certain distance. An example of this could be an archaeological excavation, in which we can make measurements from the perimeter without having to enter the archaeological tastings.
- Project in the office. By obtaining a complete model of the object/

Fig. 5. Phases of the process of generating a three-dimensional model using photogrammetry. Alfonso's oil mill in Valencia (image: Architectural Photogrammetry Laboratory, Valladolid).



building with all the geometry true to reality, we can consult the model and extract any information or measurements at any time.

- Generation of BIM modelling or faster plans. When performing scans, all the information from reality is taken to a 3D model from which the current state of the object can be modelled (Campi et al., 2017; Pepe et al., 2021).

Digital photogrammetry

Another digitization tool is the creation of 3D models from collections of photographs. These solid models will improve the level of detail compared to the point cloud models obtained with the laser scanner.

Computer advances have led to a return to photogrammetry, to the use of photographs to generate a virtual model. Although now we are not talking about stereoscopic pairs, but rather about a photographic "mosaic", a set of a large number of photographic images that, taken under certain conditions and positioning, allow the generation of a three-dimensional model with high photographic resolution.

- All these problems have been solved through the use of computer

processes; the fact of not having to develop the photographs on a physical support eliminates deformations to a certain extent, so that only the calibration of the deformations inherent to the camera lens is necessary.
- The inclusion of computerized processes in the restitution through filters or contour recognition has greatly facilitated the work; so that computing time has replaced the analytical process and, once this objective was achieved, it was a matter of time before the use of such strict conditions in data collection was no longer necessary.
- Despite this, for this type of 3D reconstruction programs to be able to align all the photographs with each other and generate error-free data, it is necessary to meet a series of conditions in the photographs. The positions of the photographs have to be different. If any coincide in the same position, it will introduce errors into the model and noise points. It is recommended that all photo collections have to be taken with the same orientation, landscape (horizontal) or portrait (vertical). Use the same focal length for an entire collection of photographs. All photographs must be well exposed, without very dark or burnt areas since in these areas the software will not be able to recognize points. The photographs must be well focused. A blurry photograph introduces errors into calculations. The reconstruction process of these programs is similar; what differs between them are the calculation algorithms, which makes some faster than others in generating three-dimensional models.
The first step once the images are loaded into the program is to calculate the orientation points between the photographs. It is very similar to the process that was carried out in analog restorers, in which the external orientation or position of the cameras is sought. Additionally, camera lens calibration data is calculated in this step. The result is a sparse point cloud or orientation cloud.
The second step is the calculation of the three-dimensional geometric reconstruction of the object. This is a very long process, since the software uses algorithms to calculate each of the points that define our object; what it does is analyze and match, in pairs, all the photographs and calculate all the points using depth maps. The result is a dense cloud

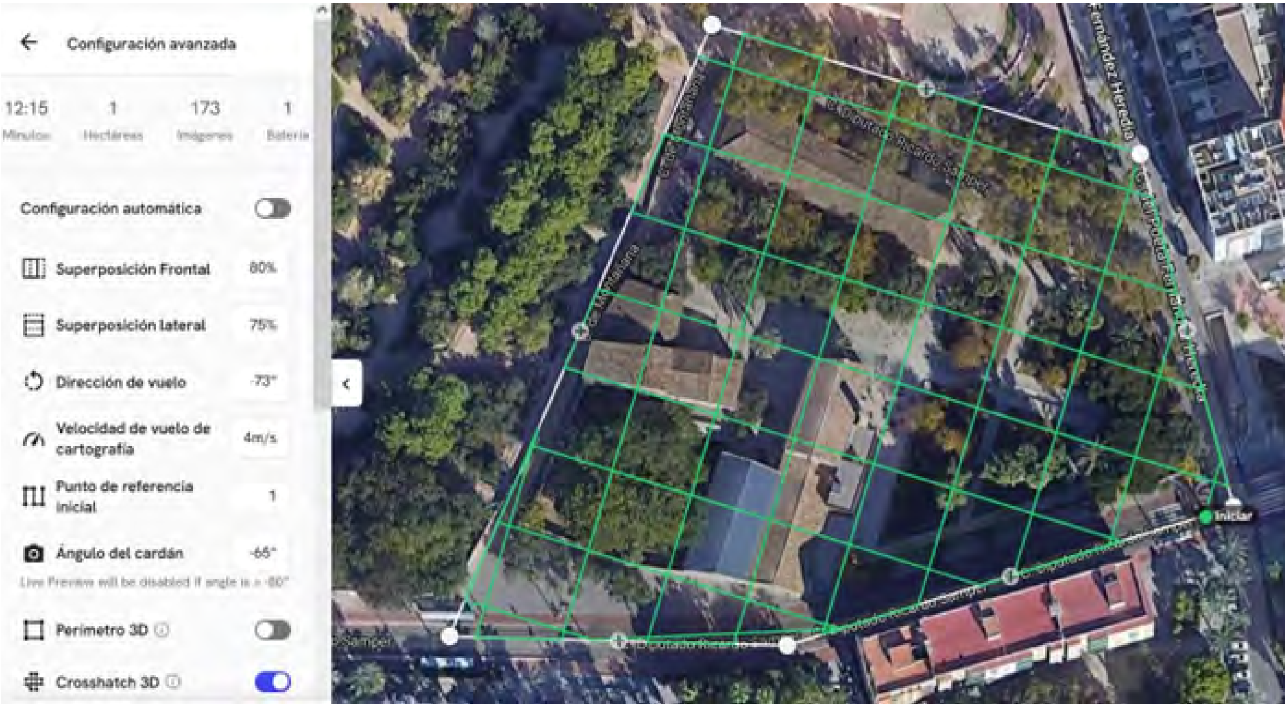


Fig. 6. Configuration window of a scheduled flight using a double grid, to obtain photographs of the Alfonso oil mill in Valencia (image: Architectural Photogrammetry Laboratory, Valladolid).

of points (Fig. 5). The next step would be the transformation of the dense point cloud into a mesh of triangles with colouring per vertex from the pixels of the photographs used in the reconstruction. Next, the mesh would be mapped or texturized from the photographs. The result obtained by processing these collections of convergent photographs is a three-dimensional mesh mapped from the photographs. These meshes allow us to obtain completely orthogonal views of the building being surveyed, providing the technician with a metric and quality drawing base. These processes can be completed through topographical support, geolocation of the survey components, or the addition of parallel survey processes that complete the model, whether three-dimensional or the two-dimensional documentation that is necessary to generate. The usefulness of having a comprehensive model of the building not only allows the preparation of semi-automatic plans, provided by the photographic ortho projections of the building's facades, but also the study of the deformations, alterations and geometry of the architecture that replaces the model. The great development that has occurred in photogrammetry, in the new digital photogrammetry, has given rise to the appearance of different modeling programs based on the registration of a collection of photographs that cover the entire volume of the building, but also of its interior. In all of them the problem to be solved is, on the one hand, to guarantee adequate overlap between the photographs taken; on the other hand, to collect all the surfaces that define the architecture of the building. Here, the problem that arises is to be able to photograph what is above our vision, what is not accessible to our camera.

The use of drones

Initially, these photogrammetric models could only be carried out at ground level or slightly elevated using expensive auxiliary means, this is what is known as terrestrial photogrammetry. But the appearance of new devices such as hot-air or captive balloons made it possible to take photographs from new, higher points of view, making it easier to document parts that until then were quite inaccessible, thus achieving 3D models with coverage of almost 100% of the documented buildings. There was only one drawback in this type of system and that was that they were uncontrollable, since the wind was what determined the movement and direction of the balloon, making the operator unable to take photographs from specific positions. For this reason, the distribution of image capture did not follow a homogeneous pattern.

This problem is today solved, in an easy and economically affordable way, with the use of photographic cameras placed on drones, more stable and controllable systems, allowing for a more precise and homogeneous distribution of image capture. The unusual views that the drone camera provides make it possible to arrange complete photographic collections of the building and, with this, the development of solid comprehensive models of high precision and definition.

Currently, capturing aerial images using drones is a process that has been simplified thanks to the development of specialized applications that allow you to create a scheduled flight (Fig. 6) by means of defining a specific area of interest by drawing a polygon on a map or satellite image. Once the study area is established, parameters are introduced such as:
- Aircraft model.
- Flight height.
- Aircraft speed.
- Longitudinal superimposition of images.
- Transverse overlay of images.
- Tilt or angle of the camera.

With automatic flight scheduling, consistent and efficient data collection is ensured, facilitating decision making based on detailed and up-to-date terrain information.

Subsequently, the integration of three-dimensional models from laser scanning and aerial photogrammetry will be necessary, a process that requires precision and attention to detail. Strategic placement of targets in the study area is essential to ensure exact alignment between the two models. These targets, distributed both on the ground and on the vertical faces of existing structures, serve as essential reference points during the data fusion process. Measuring these targets with a total station allows obtaining precise coordinates that are crucial for the calibration and spatial registration of the models. This method ensures that overlays and transitions between data captured by laser scanning and those obtained by photogrammetry are consistent and accurate, resulting in a high-fidelity composite model that can be used for various applications, such as heritage conservation, urban planning, or civil engineering. Accuracy in target placement and measurement is a critical step that should not be underestimated, as any error at this stage can propagate through the final model, affecting its quality and usefulness.

Generation of results from digital models

These digital models obtained are exact replicas of the original objects,

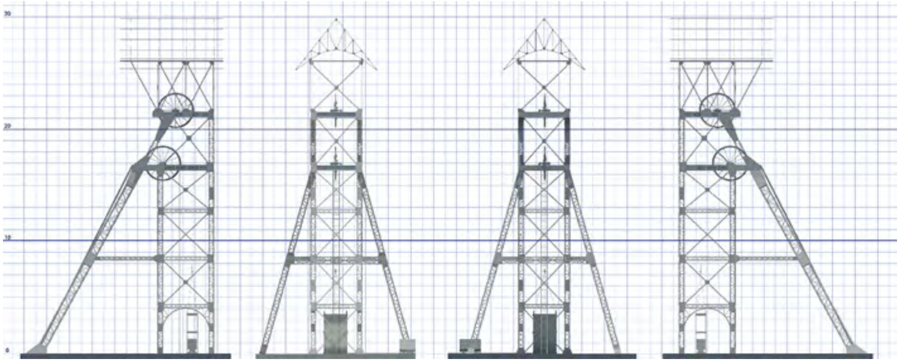


Fig. 7. Analysis of the structural elements of the tower of the Pozo Herrera I mining complex in Sabero (León) (image: Architectural Photogrammetry Laboratory, Valladolid).

containing all the geometric and colour information that is visible. The internal parts of walls or those that are hidden cannot be documented; this would require the use of other types of equipment such as georadars, X-rays, etc. to complete the documentation process.

These 3D models will allow new types of documentation to be extracted in addition to general planimetry documentation such as elevation plans and sections.

- Thematic maps, such as a damage map on facades in which all the pathologies, cracks, deteriorations and flaws are shown.
- Metric quantification; as they are exact replicas of the original documented building or object, we can measure any element at any time.
- Data verification; these models reflect with great precision the real geometry of the object, allowing the veracity of documentation prior to data collection to be verified with these tools. An example of this is checking the geometry of a building's floor plan.
- Constructive analysis; the great geometric and color precision of the 3D model allows you to study the stone pieces or the different construction elements, allowing you to analyze the different construction phases of the building.
- Structural analysis of all the elements that appear in the model, being able to study their dimensions, deformations, etc. (Fig. 7).These models have a drawback, and that is that they are the result of massive data capture

Fig. 8. Photograph of the abandoned mining complex of Pozo Herrera I in Sabero (León) (image: Architectural Photogrammetry Laboratory, Valladolid).

without discriminating anything. So, they have a lot of information, and they are files that take up a lot of space, being heavy to handle. For this reason, it will be essential to create a model with simplified geometry using computer-aided design (CAD) programs. This allows the complexity of the models to be simplified, thereby reducing file size, and improving efficiency in data processing and manipulation. Creating models with simplified geometry is a common practice in various industries, especially when it comes to handling large volumes of data. This approach not only optimizes the storage and management of computing resources, but also facilitates visualization, simulation, and analysis in real time, which is crucial in fields such as engineering or architecture, where speed and precision are fundamental. These simplified models will also allow us to make animations using virtual or augmented reality processes to explain how they work and thus understand the manufacturing process carried out in them. These animations are a valuable educational tool, providing an immersive experience that improves understanding and retention of information. Without a doubt, virtual and augmented reality are setting a new standard in training and skills development in the heritage documentation sector. An example of this could be the 3D models made of the Pozo Herrera I mining complex located in the Sabero area (Fig. 8). It began operating in 1915 and closed around 1950, being the first vertical well built in the province of León, reaching a depth of 150 m. This

Fig. 9. Simplified 3D model used to disseminate the coal extraction processes of the Sabero mining basin (León) (image: Architectural Photogrammetry Laboratory, Valladolid).

model becomes an example of dissemination to explain the operation of the coal extraction process to the surface through the machinery and the most important buildings of the complex (Fig. 9).

Conclusion

Laser scanning and photogrammetry are essential tools for capturing three-dimensional data, allowing precise and detailed measurements of objects and environments to be obtained. These technologies are crucial in heritage documentation and preservation, as they provide a solid foundation for research and conservation. The resulting digital models are valuable tools for recording and inventory, as well as for planning and executing conservation and restoration interventions. Furthermore, these models are fundamental for the dissemination of heritage, facilitating public access to digital replicas of sites and objects that may be fragile or inaccessible. The complexity of photogrammetric models reflects the richness and precision of the data captured, but also requires a simplification process for use in different applications, such as virtual reality or educational video games. This simplification process must balance model fidelity with processing efficiency and ease of use, ensuring that models are both accurate and accessible.

Notes

[1] https://www.un.org/sustainabledevelopment/es/cities/

[2] https://blogfundacion.arquia.es/2019/02/2030-el-papel-del-patrimonio-industrial-en-los-objetivos-de-desarrollo-sostenible.

[3] Term frequently used to refer to airborne laser scanning but also applied to some ground systems.

[4] Laser (acronym for Light Amplification by Simulated Emission of Radiation), is an intense beam of light that produces images with electronic pulses.

[5] Set of XYZ coordinates in a three-dimensional coordinate system. It may also include additional information, such as color and reflectivity values.

References

Campi, M., di Luggo, A., & Scandurra, S. (2017). 3D modeling for the knowledge of architectural heritage and virtual reconstruction of its historical memory. In *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XLII-2/W3, pp. 133-139.

Cervera Vera, L. (1984). Iglesia de Arcas (Cuenca). In *Iglesia de Arcas (Cuenca)*. Diputación Provincial de Cuenca.

del Pozo, P., López González, A., Pascual Ruiz-Valdepeñas, H., & Calderón, B. (2008). *Territorio y patrimonio industrial en Castilla y León*. Univesidad de León, Secretariado de Publicaciones.

Garcia Fernandez, J., Socci, L., & Fernandez, J. (2013). Methodology of efficient assessment of structural deformation from non-intrusive techniques for civil heritage conservation. In *Second conference on smart monitoring, assessment and rehabilitation of civil structures*.

Marcos, D., García, L. A., San José, J. I., & Sánchez, J. I. (2016). Virtualización del patrimonio arquitectónico caído. La Torre de la Iglesia de San Esteban en Valdespina, Palencia. In Aa.Vv. (Eds.). *REHABEND 2016*, p. 339. Spain: Gráficas Iguña, S.A.

Pepe, M., Domenica, C., Alfio, V., Restuccia, A., & Papalino, N. (2021). Scan to BIM for the digital management and representation in 3D GIS environment of cultural heritage site. In *Journal of Cultural Heritage*, Vol. 50, pp. 115-125.

Vacca, G., Mistretta, F., Stochino, F., & Dessi, A. (2016). Terrestrial Laser scanner for monitoring the deformations and the damages of buildings. In *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XLI-B5, pp. 453-460.

Study of historical cartography for a comprehensive knowledge of industrial heritage

Miguel Sancho-Mir; Beatriz Martín-Domínguez & Angélica Fernández-Morales

The transformation of productive uses resulting from the industrial revolution had important repercussions on the morphology and functioning of cities, although this process did not have the same impact everywhere, generating great differences between industrialised areas and those that remained more on the fringes of this phenomenon, between the urban and the rural.

The establishment of new industries that required large spaces took place mainly in peri-urban areas, in some cases coexisting with existing uses and in other cases displacing or amortising them, as tanneries, mills and potteries had already coexisted with agricultural and forestry operations in these areas.

The growth and structural expansion of cities during the nineteenth century and more markedly in the twentieth century meant that, in many cases, industries that were born practically isolated were absorbed into the fabric of the city, which radically changed their immediate context, which, moreover, have suffered the abandonment of production and currently, the factories of the first industrialisation that are still active are scarce (Biel, 2016, p. 161). This transformation of the environment, the relationship of these buildings with a new urban reality is a process that has characterised a large part of Industrial Heritage and has made it particularly sensitive, as it has suffered real estate pressure in such a way that many of these complexes have been victims of speculation and have been demolished, a phenomenon that we continue to suffer in our cities

Fig. 1. Evolution of the surroundings of the Parellada tile factory in Zaragoza between 1869 and 1908 (GRAPHyC with cartographies from: Geographic Documentation Service and Library of the National Geographic Institute (IGN) (Spain)).

and that in the case of Zaragoza, the recent demolition of a large part of the Averly Foundry is a good example of this.

Fortunately, a greater awareness of the values of industrial heritage and its potential for new uses has led to many of these buildings being preserved and reconverted, mainly as new spaces for leisure and culture. But this trend is not without its dangers, since, as Professor Pilar Biel points out (Biel, 2016, p. 176): "In a large number of cases, this accommodation is carried out on protected buildings where legal protection has not been a limit or an obstacle to prevent their emptying, the elimination of their structure or the amputation of part of their elements. These intervention criteria are not questioned, and the relevance of their use is not subject to criticism, even though the buildings on which intervention is carried out belong to the cultural heritage of society. In short, industrial heritage is subjected to a trivialisation typical of the post-industrial society that leads citizens to lose awareness of the importance of the history of work, a key stage without which it would have been impossible to reach the current situation".

This reflection reaffirms the needs of architectural and urban heritage in terms of the protection of its values, with instruments such as the correct cataloguing, the necessary enhancement, through research, dissemination and, if necessary, intervention, and always together with preventive conservation.

In the face of changing theories on the conservation of architectural and urban heritage, one approach is irrefutable: the need for a comprehensive knowledge of it in order to identify its values and be able to protect them. To this end, the architectural survey is an indispensable step, which, together with a study of the different existing sources, can reconstruct as accurately as possible the life of the building: its different construction phases, the material, functional and stylistic characteristics in relation to the period in which they were built. But, furthermore, a heritage asset should not be understood as an isolated element, as it is largely a consequence of the environment in which it is located and this also evolves, changes over time, and these changes affect its image, the way it is perceived from the outside, and also its function, the way it is used, which is why it should be studied as an indissoluble whole. In this sense, studies on the evolution of the landscape and urban morphology are essential.

Cartography, by its very nature and purpose, is presented as the main source of information on the evolution of urban form, which is why the study of historical cartography is established as an essential stage for a comprehensive knowledge of architectural and urban heritage. The aim of this text is precisely to explain a methodology for analysing cartographic and aerial photographic documentation with technical rigour for the study of the historical image of the city or territory.

The proposed procedure proposes the coordination of cartography based on the georeferencing or georectification of previously digitised historical planimetries and their subsequent vector restitution, resulting in what we call a historiographic cartography, as they have been prepared with the aim of studying history, in this case architectural and urban heritage through the critical analysis of the sources.

A prior search, study and selection of the existing cartography must be carried out, taking into account its chronology, relevant data provided, definition and the evolution of the field of study itself. In the search for historical cartographies, it is necessary to search the different public and private archives at municipal, regional, national, or international level, as

Fig. 2. Some maps of Naples in the 19th century (GRAPHyC with cartographies from: Utrecht University Library, Harvard University Library and SDUK).

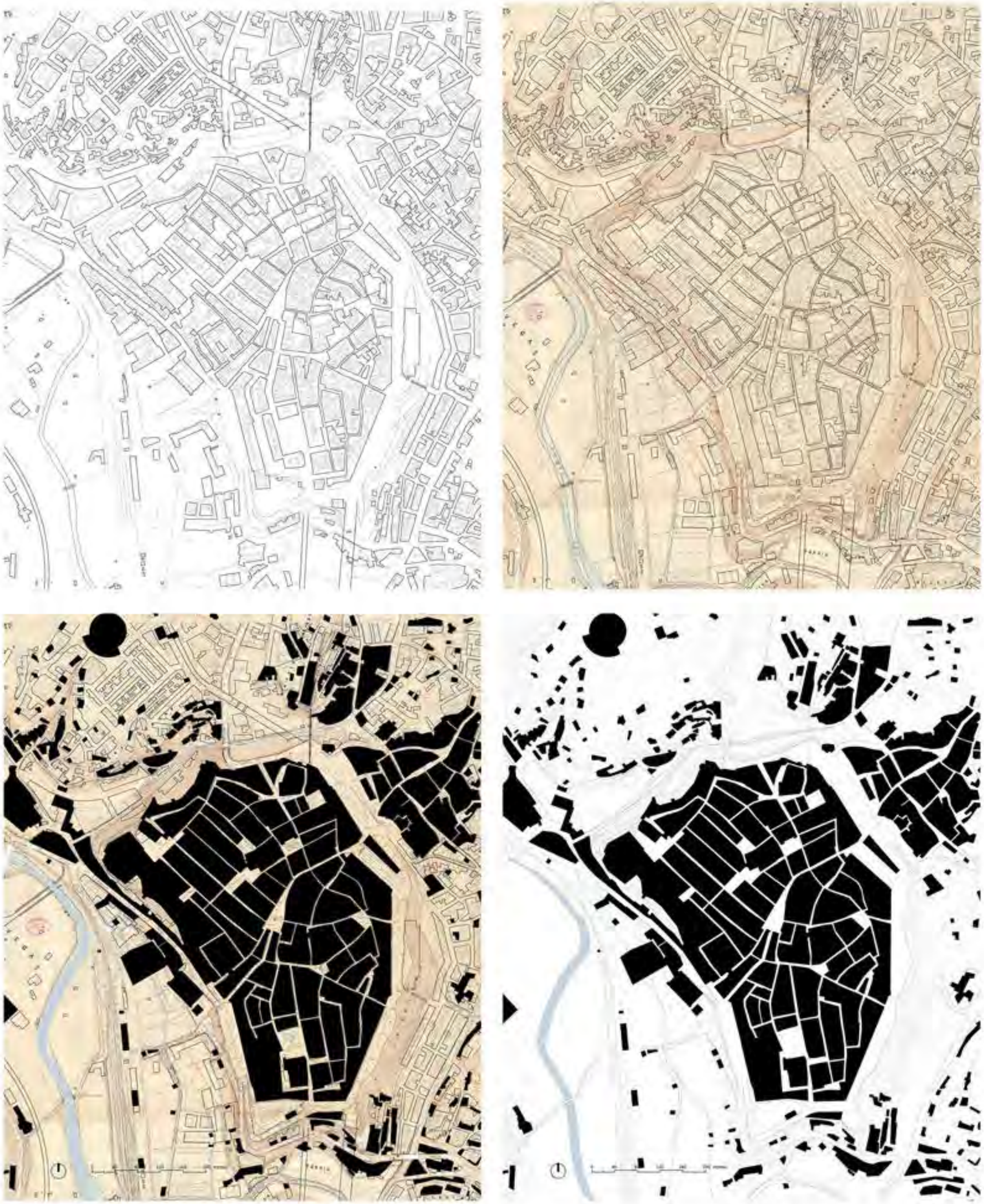
well as the geoportals of spatial data infrastructures that facilitate the dissemination of geographic information.

Cartographic coordination is a "verification of relationships between cartographies from different periods, taking as support points the permanencies or invariants that ensure comparison throughout the sequence studied" (Cordovez, 2008, p. 68). This is an inverse process, in which work begins with the most recent cartography, which is more precise, and gradually advances to the oldest, thus making it possible to evaluate and correct a large part of the errors derived from cartographic inaccuracies.

It is very important to have a base cartography of proven rigour, as the precision of the procedure is based, to a large extent, on this geometry. For this purpose, it is preferable to make use of the various official institutions that must ensure the quality and traceability of the geographic information supplied, and to study and store the metadata associated with it. If an official cartographic base is not available, other open access sources can be used, such as the geographic information of the OpenStreetMap (OSM) collaborative project, but in this case, although the current greater availability of aerial photographs and the use of other commercial and public data sources have allowed for greater accuracy, it is necessary to be aware of their degree of reliability.

Likewise, it is necessary to assess that the scale of the base cartography is appropriate to the scale of the historical cartography studied, since the cartographies made for small scales, designed to define a wide area of territory, usually have less detail derived from the process of simplification of the geometry represented, known as generalisation. Another fundamental aspect is the control of the datum used, which provides a valid reference frame. It is advisable to use the official geodetic reference system of the place of study, which should be the one used in the base cartography, in the case of Spain (ETRS89). In this case, the cartography must be georeferenced in this system in UTM projection, as well as the new cartography generated. This facilitates the interoperability and comparative study of cartographies with the required accuracy.

To carry out the coordination, the cartography is georeferenced or georectified, as appropriate, and, after comparative analysis, the resulting map of the corresponding period is restored in vector format. This mapping serves as the basis for the following coordination and planimetric



restitution, in this way always working on a reliable basis, thus reducing the accumulated cartographic error to a minimum.
Georeferencing is the process in which a map is assigned a metric reference relative to a global coordinate system or its equivalent cartographic projection system (Balleti, 2006, p. 34).
This must start with the previous work of preparing the cartographic material, which consists of the rasterisation of the plans through contact scanners or other photogrammetric procedures (Ballarin et al., 2015;

Fig. 3. Vector restitution process of the 1912 plan by georeferencing it (order from right to left and from top to bottom) (image: GRAPHyC).

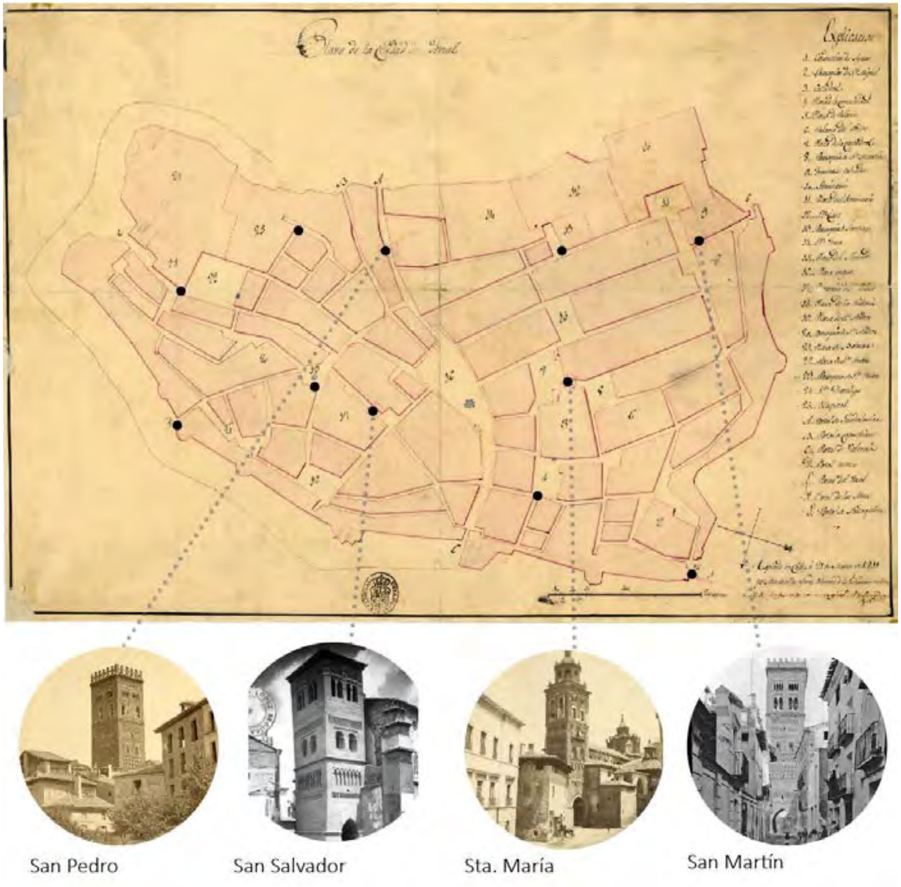


Fig. 4. Selected invariant points for the georeferencing of the map of the city of Teruel copied in 1811, including buildings such as the four Mudejar towers, which are a World Heritage Site (image: GRAPHyC).

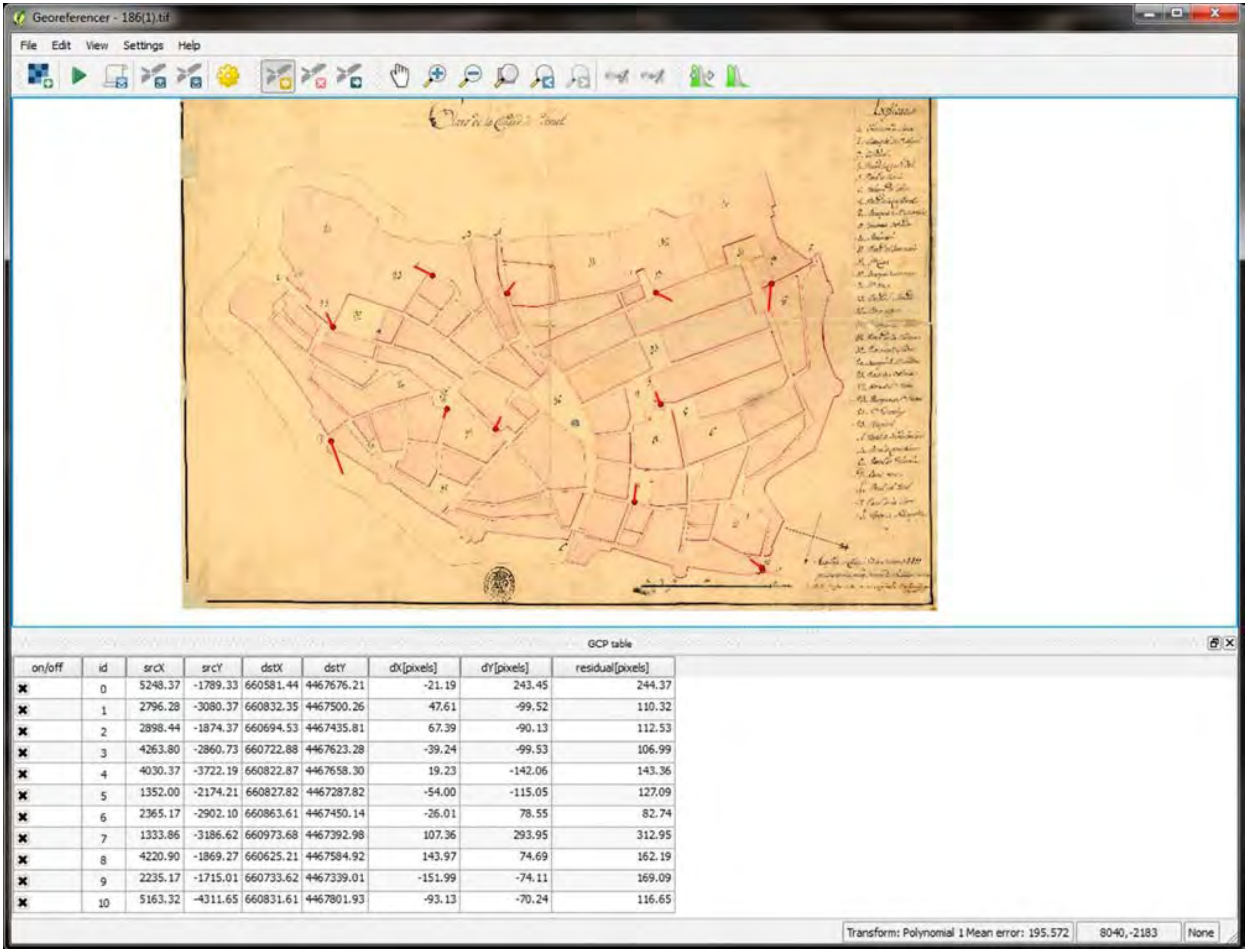


Fig. 5. Residual value, graphic and numerical, of the control points of the map of the city of Teruel copied in 1811 (image: GRAPHyC).

Ballarin & Vernier, 2014). The digitisation of cartographic material must be a methodical process in which all possible information associated with the treated element is recorded in a database (Chías & Abad, 2008).

Once the cartographic material has been digitised, the colour, brightness and contrast levels can be readjusted, if necessary, due to the tonal distortion that can be produced by scanning (Cid, 2014). After this first preparatory phase, the next step consists of identifying common points of the reference plane with the plane to be georeferenced, these are the so-called invariant points or control points, and the most suitable are points conveniently distributed and easily recognisable on the plane, belonging to constructed buildings that have not undergone modifications over time that affect their footprint on the plane (Baiocchi & Lelo, 2005, p.115), so this process requires sufficient knowledge of the area of study. In short, it is a matter of assigning coordinates to certain points on a map in a previously established system, an assignment that is carried out in a Geographic Information System, which also allows control of the existing error in the cartography. To do this, a transformation is applied with an algorithm that performs the rotation, scale and translation of the raster, without deformation, and the software calculates in pixels the residual values of each control point, graphically and numerically, and the average residual value. Having the original size of the document and its scale, the error in the metric system can be obtained.

Once the accuracy of the map has been checked, a georeferenced raster file is generated and can be inserted with the reference cartography. In the event that the cartographic quality of the map is not sufficient, which is usually the case with historical cartographies, the process must be redone, applying a transformation with an algorithm that allows a global deformation of the raster, in order to achieve a better adjustment to the reference plane; in this case it would be a georectification and a greater number of reference points is necessary, which will depend on the algorithm used. If with this procedure the adjustment is not acceptable, it would be necessary to resort to a transformation with an algorithm that allows local deformations, suitable for cartographies with low topographic precision.

The proposed methodology uses QGIS, a free and open-source cross-platform geographic information system with a georeferencing tool that allows the georectification of rasters [1]. This tool allows, once the vector base layer is loaded in the programme, to add the historical cartography

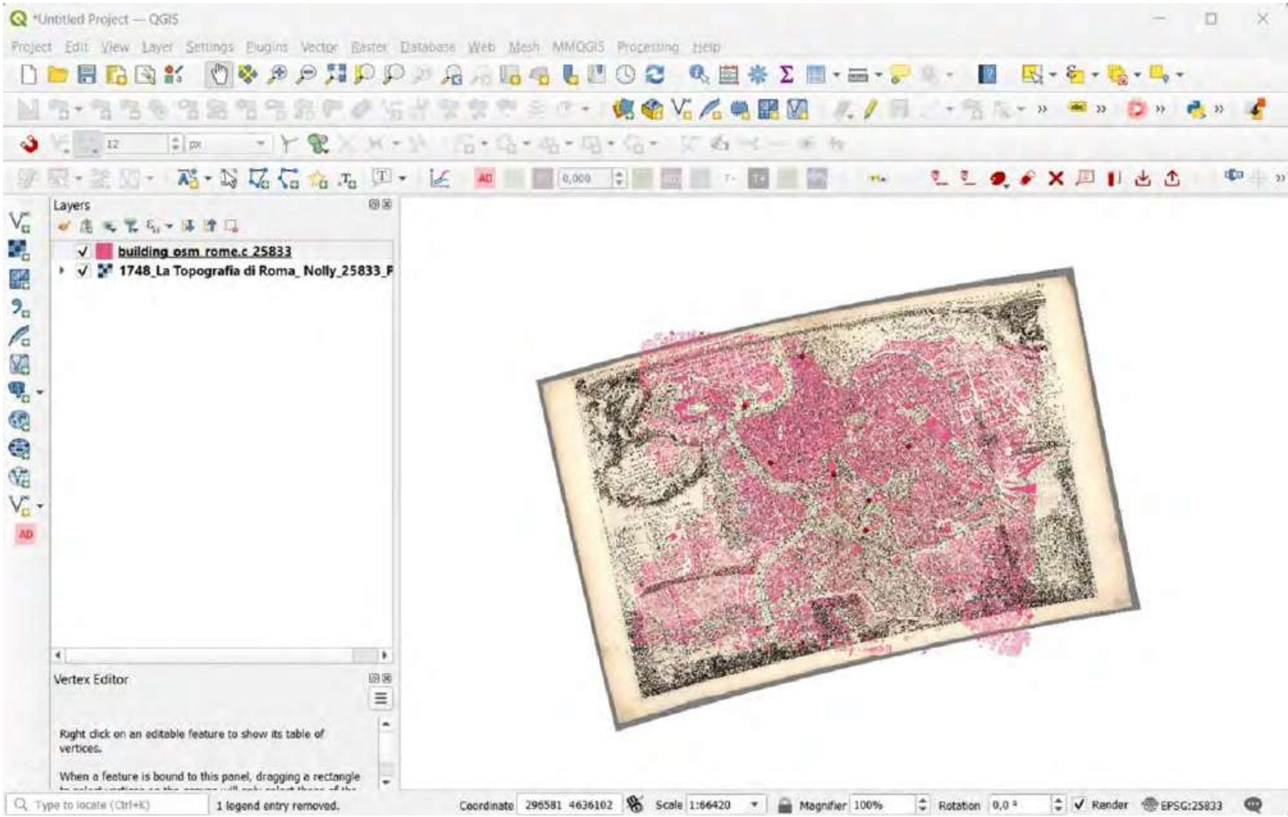


Fig. 6. Georrectification of La Topografia di Roma elaborated in 1748 by Gio Battista Nolly (image: GRAPHyC).

in raster format, and to define, among other aspects, the algorithm or type of transformation, the Reference Coordinate System, which must be the same as the base layer, and the resampling method. Once the transformation configuration has been defined, the ground control points (GCPs) are introduced, which can be done graphically with the reference cartography. Regarding the types of transformation, in the current version, we can choose between:

- The Linear algorithm It allows positioning (translating) the image and uniform scaling, but no rotation or other transformations. (At least 2 GCPs are needed).

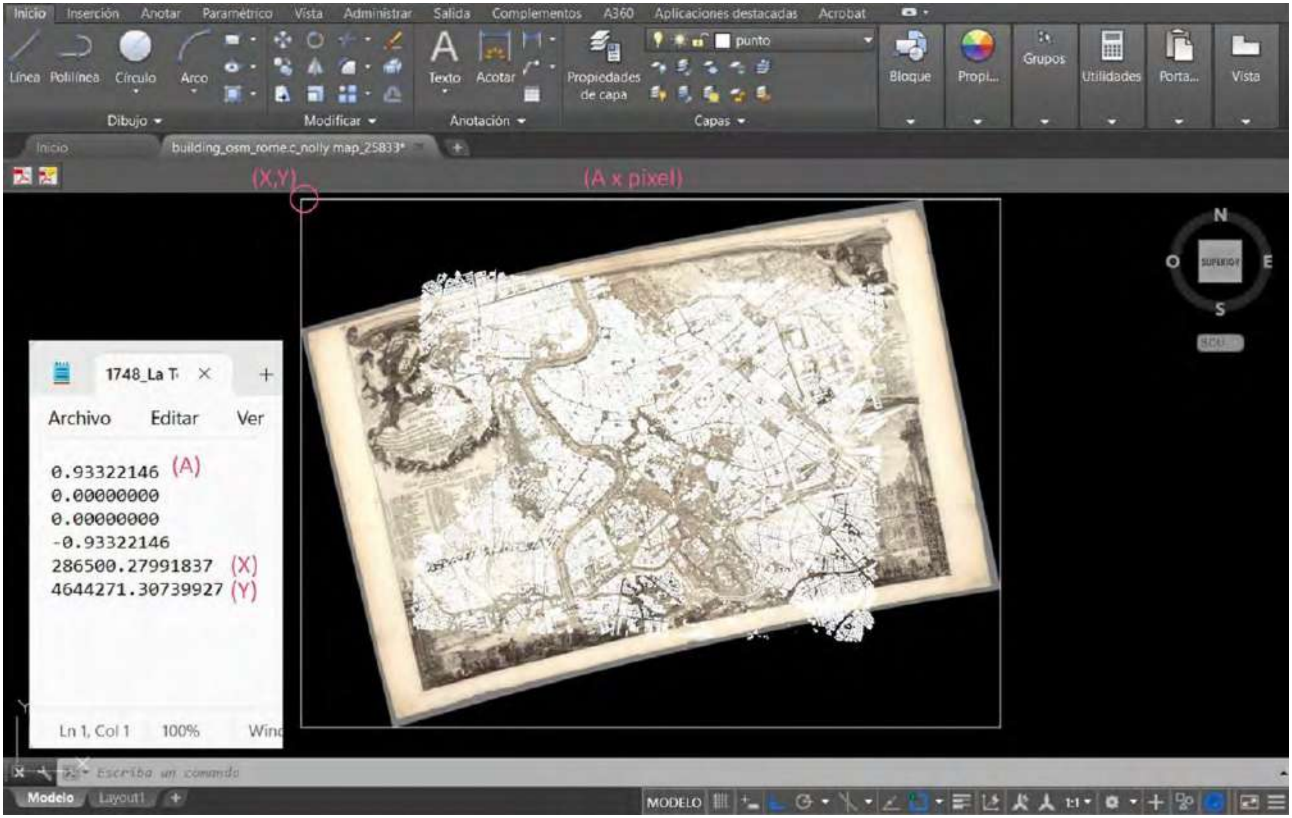


Fig. 7. Georetified cartography of La Topografia di Roma elaborated in 1748 Gio Battista Nolly georeferenced in CAD (image: GRAPHyC).

-The Helmert algorithm allows positioning (translating) the image, uniform scaling, and rotation. (At least 2 GCPs are needed).
-The Polynomial 1 algorithm allows a more general affine transformation, in particular also a uniform shear. (At least 3 GCPs are needed).
- The Polynomial 2-3 algorithm allows them to account for curvature or other systematic warping of the image. (At least 6-10 GCPs are needed).
- The Projective algorithm generalizes Polynomial 1 in a different way, allowing transformations representing a central projection between 2 non-parallel planes, the image and the map canvas. (At least 4 GCPs are needed).

- Thin Plate Spline (TPS) algorithm allows local deformations. Areas away from GCPs will be moved around in the output to accommodate the GCP matching but will otherwise be minimally locally deformed. (It technically requires a minimum of 10 GCPs, but usually more to be successful).

These options allow the operations described above to be performed for georeferencing, georectification and error control of the historical cartography.

It should be noted that the inaccuracy of historical cartographies may be due not only to the quality of the survey, but also to the degradation of the physical support, the digitalisation process or the cartographic generalisation used for smaller scale plans or maps. In this case, the inaccuracies derived from the projection system used for the scale of the cartographies used for the study of urban and architectural heritage have been ignored. The inaccuracy of some graphic documents may make it inadvisable to use them as geometric references, but they can still serve as information on the layout, the road network or the size of public spaces, among other important features.

Once the cartography has been georectified, the vector restitution of the historiographic cartography is carried out, whose elaboration should not be based on the simple transcription of the traces, but on a critical and comparative analysis, such as the comparison of the historical plans by applying a percentage of transparency to the raster (Chías & Abad, 2009, p.63), which facilitates the interpretation of the data provided, for which it is necessary to take into account the variable reliability of the source by calculating its cartographic error or the intention and origin of the source itself, which often leads cartographers to not reflect the existing reality, so that in this process it is essential to study and contrast the different sources available.

The vector restitution process can be elaborated in the Geographic Information System itself by creating a new vector layer for each type of geometry required, whether point, line or polygon, but it can also be done in CAD software, for which the base layer must be exported in .dxf

format and the positioning data of the georeferenced image must be extracted and both layers in the same Coordinate Reference System. The vector layer must be converted from polygon to line before exporting, otherwise it will be exported as a hatch. In the case of the raster layer the projection must be extracted which generates a world file (.wld or .tfw) and to be georeferenced in the cad program it is necessary to open this file with a text editor and interpret the data provided in the six rows:
Line 1: pixel size in the x-direction in map units (meters)
Line 2: rotation about y-axis.
Line 3: rotation about x-axis.
Line 4: pixel size in the y-direction in map in map units (meters)
Line 5: x-coordinate of the upper left corner of the image.
Line 6: y-coordinate of the upper left corner of the image.
As pixels are considered as square lines 1 and 4 are the same, lines 2 and 3 are zero in this type of images as they are generated without rotation, so to georeference the image correctly it must be scaled by multiplying the pixel dimension of the image by the pixel size in that direction and take as positional reference the upper left point of the image.
The lack of historical cartography prior to a certain date can force us to make hypotheses. A process which, based on the coordination and cartographic restitution carried out, must be based on the law of the persistence of the plan, since, as Professor Beatriz Arizaga explains: "The urban plan, whose basic elements are the public road network and the plot, persists over time, from the first foundation with greater or lesser success. We can compare it to parchments that are reused, rewritten. It seems that nowadays the law of the persistence of the plan is fully accepted, since buildings are replaced over time, but plots and road networks can remain" (Arizaga, 2002, pp. 69-70).
And, furthermore, in the information provided by the various documentary or archaeological sources, which will modify or confirm the aforementioned permanence, with which sufficiently reliable hypotheses can be established (Cárcel-García, 2016, p. 255). Reliability that is greater the more precise the knowledge of the urban history of the city and

the closer it is, chronologically speaking, to the last contrasted graphic reference, but which is always subject to the appearance of new data that modify the urban morphology proposed.

The restitution of historiographic cartography is established as a reliable and rigorous means of studying the evolution of the urban form of the city, and therefore, as a procedure that complements the integral knowledge of the architectural and urban heritage. Thanks to Geographic Information Systems, it is possible to control the error of the historical cartography used and, therefore, its reliability. The study of the different existing sources, together with the necessary cartographic concepts and the use of the digital tools employed, are the only conditioning factors for the correct application of the proposed method to urban environments other than the case study.

The work for the writing of this paper has been carried out in Grupo de Representación Arquitectónica del Patrimonio Histórico y Contemporáneo. GRAPHyC, Ref: H32_23R. University of Zaragoza.

Notes

[1] Currently this tool also allows working with vector layers, but for the proposed methodology only raster is required.

References

Arizaga Bolumburu, B. (2002). *La imagen de la ciudad medieval: la recuperación del paisaje urbano*. Santander: Editorial de la Universidad de Cantabria.

Baiocchi, V., & Lelo, K. (2005). Georeferencing the historical maps of Rome between the seventeenth and eighteenth centuries. In *CIPA 2005 XX International Symposium-International cooperation to save the world's cultural heritage*, pp. 114-118.

Ballarin, M., Balleti, C., & Gottardi, C. (2015). Automatic Systems for Digitizing Historical Maps. In *e-Perimetron*, Vol. 10, No. 1, pp. 21-29.

Ballarin, M., & Vernier, P. (2014). Digitization of Maps Belonging to Cultural Heritage. In *e-Perimetron*, Vol. 9, No. 4, pp. 196-205.

Balleti, C. (2006). Georeference in the analysis of the geometric content of early maps. In *e-Perimetron*, Vol. 1, No. 1, pp. 32-42.

Biel Ibáñez, M. P. (2016). El patrimonio industrial en el siglo XXI y su relación con la ciudad posindustrial. In A. Hernández Martínez (Ed.) *Conservando el pasado, proyectando el futuro: tendencias en la restauración monumental en el siglo XXI. Preserving the past, projecting the future: tendences in 21 st century monumental restoration*, pp. 157-176. Zaragoza: Institución ”Fernando el Católico”.

Cárcel-García, C. (2016). La cartografía histórica como método de estudio morfológico del paisaje tradicional de Campanar. In *EGA. Revista de expresión gráfica arquitectónica,* Vol. 21, No. 27, pp. 254-261.

Chías, P., & Abad, T. (2009). GIS tools for comparing historical and contemporary landscapes through local map series. In *e-Perimetron,* Vol. 4, No. 2, pp. 61-72.

Chías, P., & Abad, T. (2008). A GIS in Ancient Cartography. In *3rd International Workshop– ICA Commission on Digital Technologies in Cartographic Heritage. Barcelona*. pp. 290-296.

Cid Mendoza, A.del (2014). Cartografía histórica y nuevas tecnologías para el análisis urbano: la Granada de finales del siglo XIX. In *Seminario Internacional de Investigación en Urbanismo "VI Seminario Internacional de Investigación en Urbanismo, Barcelona-Bogotá, junio 2014",* No. 6. Barcelona: Departament d'Urbanisme i Ordenació del Territori. Universitat Politècnica de Catalunya.

Sancho Mir, M., Agustín Hernández, L., & Llopis Verdú, J. (2017). Análisis y generación de cartografías historiográficas en el estudio de la evolución de la forma urbana: el caso de la ciudad de Teruel. In *EGA. Revista de Expresión Gráfica Arquitectónica*, Vol. 22, No 30, pp. 180-189.

Temes Cordovez, R. R. (2008). Las fuentes catastrales y la identificación de las transformaciones en los tejidos inversos. In *CT: Catastro*, No. 64, pp. 55-78.

Refurbishing the Industrial Heritage in the age of transition

Paola Ascione

Introduction

The redevelopment of places born with and for industry requires complex and long-term processes, investing interventions of different scales and magnitudes, from reclamation operations to reuse and redevelopment issues, from urban to architectural scales.

A motivation for urgent action is the National Recovery and Resilience Plan (PNRR). In light of the Plan, disused industrial heritage could take on a new centrality if seen as a potential resource for the hoped-for recovery. There are many experiences since the turn of the millennium that can be regarded as a basis for comparison for different approaches to regeneration and redevelopment. Vast areas once earmarked for manufacturing plants are now large parks where designed greenery, mainly not spontaneous, symbolically takes over from old buildings: smokestacks and steel mills that once discharged polluting fumes now stand as monuments/ruins, icons of a past civilization.

But there are still too many brownfield sites and buildings abandoned to decay without adequate projects. Many questions are still open including the conflict between cultural aspects and technical-economic issues that inevitably slow down the decision-making process. Meanwhile, the question that the scientific community needs to address concerns the real possibility of looking at industrial archaeology as a heritage to be enhanced, recognizing in industrial ruins resources and potential for the contemporary project of redevelopment of the existing.

Fig. 1. Van Nelle Fabriek, Rotterdam, Johannes Andreas Brinkman, 1925-1931. Design Reuse by Wessel de Jonge 1999-2004 (Paola Ascione, 2008).

Fig. 2. Van Nelle Fabriek, Rotterdam, Johannes Andreas Brinkman, 1925-1931. Design Reuse by Wessel de Jonge 1999-2004. Facade (Paola Ascione, 2008).

Archaeology or Industrial Heritage?

The delicate passage from the concept of Archaeology to the concept of Heritage, shifts the focus toward a more conscious recognition of the peculiarities of former factories, not always ascribable to mere historical evidence of a production cycle. In fact, the term Industrial Archaeology originated in England around the 1950s as a designation for a new discipline that studies the artifacts and evidence from the era of the Industrial Revolution (machines, buildings, technologies, infrastructure) and the economic and social effects that follow. Specifically, Industrial Archaeology is the science that studies the origins and development of the machine civilization and the marks left by the industrialization process in daily life, culture and society, and "of which both the content and the denomination itself are debated" (Corti, 1991). Conversely, the term heritage for us architects here take on a double meaning, delimiting the field of investigation to the buildings and settlements that are the subject of the intervention and at the same time restoring an implicit value to these objects by entrusting the landscape and industrial architectures with a denser signification than the mere aesthetic or documentary bearing. Essentially, the locution Industrial Heritage is charged with the added value of heritable property. In line with Faro's assertion (Faro Convention, 2005), when we speak of heritage, we are referring to the value of a legacy used wisely as a resource for sustainable development and improvement of urban quality. Hence the need to unveil the peculiarities of what emerges in the most negative sense as waste or at most as inconvenient testimony of a dying civilization, evoking hard work, source of disease, environmental damage. How willing are we today to take action for in-depth knowledge of the sites also interfacing with the communities involved? Aipai, the Italian Association for Industrial Archaeological Heritage, has activated an observatory and urges institutional parties to monitor ongoing and upcoming PNRR programs and projects that variously affect industrial heritage. Certainly, European funding for national recovery can trigger virtuous development actions for projects on brownfield sites, including and especially on those sites of recognized architectural and/or landscape interest, still awaiting urgent interventions for the necessary safety and preliminary to redevelopment. The fear is that the procedures determined by the tight timeframes for design and execution of works, do not reserve sufficient space for the knowledge and verification activities that redevelopment programs would require.

Criticality and quality of modern industrial heritage

The issue of the transmission of industrial testimonies to posterity becomes particularly delicate in the case of more recent artifacts. It was not until 2011 that Walter Gropius's Fagus Workshops, the first case of modern architecture for industry, were inscribed on the UNESCO World Heritage List (WHL), some 30 years after the Wieliczka Mine, the first industrial site to become a World Heritage Site. The late recognition of the Fagus Werk demonstrates the slow pace of interest in warehouses, plants, and infrastructure. Equally late is the recognition as a universal good of Olivetti Industrial City in Ivrea, a unique case nationally and worldwide, which is considered a true laboratory for leading Italian architects, an example of a way of conceiving architecture "with and for industry" that embodies the Olivettian thought of Community.

Docomomo Italia (DOcumentation and COnservation of buildings, sites and neighbourhoods of the MOdern MOvement) has been reporting for years on the poor state of preservation and the risks to the heritage in the SOS '900 column on its website. The association's interest is focused on the sites and architectures that constitute the outcomes of the architectural culture of the twentieth century; among them, factories and plants that were fertile ground of experimentation of the Modern, a privileged place of innovation in the field of structural engineering but also of technological solutions and construction systems that drew inspiration from the product and industrial culture.

Thanks to the audacity of skilled professionals, the construction of sheds and plants returned new typological models and a solid basis for verification of the knowledge achieved in science through new disciplines, aimed at understanding the potential of structures and other parts of the

Fig. 3. Cartiera Burgo, Mantova, Pier Luigi Nervi, 1960 – 1964. Design recovery and redevelopment by Studio: Massimo Narduzzo / CREA.RE. (Massimo Narduzzo, Rehabilitation of Cartiera Burgo in Mantova, Docomomo fiche https://www.docomomoitalia.it/wp-content/uploads/2021/03/cartiera-burgo-eng.pdf).

building system arising from the use of new materials (from cast iron to steel, from reinforced concrete to glass) as well as the new products of the building industry.

The higher the threshold of experimentation, technological-constructive and structural, contained in an industrial building, the more the fragility of the architecture increases in terms of durability and material and mechanical strength. Demolition may appear to be the most cost-effective solution in economic terms, but it can have serious issues in terms of environmental cost (think of the problems of remediation and the production of nonassimilable waste from a circular economy perspective). Unfortunately, there are not a few cases of demolition of factories of fampus designers. The latest report received by Docomomo concerns the Masterplan planned for the former Necchi area of Pavia, where the 1960-1961 expansion designed by Marco Zanuso is at risk. Bulldozers have already demolished much of the AD2-Necchi and Scalo FS compartment where Zanuso's pavilion falls. On the other hand, the Piano di Governo del Territorio (PGT) allocates the entire area for demolition, except for the first Necchi factory from the early 20th century, which is instead constrained and would remain the only survivor within the new neighborhood paradoxically named "Supernova" after one of Necchi's most famous sewing machines designed by Nizzoli in 1954, which was awarded the Compasso d'Oro Prize in the same year. In fact, the risk of demolition is higher where the factory designed by great architects, would have difficulty in the recognition of protection as it would not yet have completed 70 years since its construction as required by the regulations.

Industrial heritage must earn a living

"*Any attempt to understand why those factories and silos look so beautiful to us now must also try to understand the ambitions, the expectations, the mindset that drove the founding fathers of the Modern Movement to adopt these monuments as models for their new architecture* " (Banham, 1986). Reyner Banham's words connect aesthetic bearing and deeper meaning of modern artifacts. The density of meanings, aesthetic and symbolic, can become key to contemporary design. Without attention "...to the meaning that the factory encloses in its walls, to the use that has been made there of construction technologies and procedures, to reiterate needs, to emphasize vocations" (Zorgno, 1998) the redevelopment project risks not going beyond the ruins, at best included in the contemporary project as a commemorative "document," which does not go beyond the evocation of a forced industrial aesthetic. The search for a balance between continuità and change is always desirable in interventions on the existing. Our task today is to observe, monitor and act responsibly to put values/resources back into circulation. Difficult to generalize, each case is case by case, due to contingent issues. In the words of Louis Bergeron 'industrial heritage has to make a living,' it is preserved provided it is assigned a role in response to current demand. One has to come to terms with the financial conditions and operating costs that are not inseparable from identifying a useful and compatible reuse. In most cases, former industrial warehouses currently contain large and flexible spaces that can be adapted to new and varied functions. The

Fig. 4. "The Haunted House" Fondazione Prada, Milano. Reuse of the ancient distillery by OMA (Paola Ascione, 2023).

Tate Modern in London or the Van Nelle Factory in Rotterdam (Aa. Vv., 2005), have for years demonstrated the capacity of these containers to absorb different usages while maintaining their own identity. From exhibition galleries to performing and creative activities, to service sector activities, to new places for social interaction, work, culture, artistic experimentation, and leisure.

Questioning the measure of contemporary design today, in the light of the experiences of brownfield redevelopment and industrial architecture, shows how we have not yet arrived at the large-scale diffusion of good practices, which nevertheless exist in Italy, as demonstrated by the recent intervention on the Burgo Paper Mill, which started from the recognition and enhancement of the intrinsic qualities of Nervi's architecture. The Paper Mill (1961-64), a unicum in the design career of Pier Luigi Nervi, revealed the great expressive power and value as an icon of modern industry, welcoming in itself all the originality of a manifesto work, where the ancient synthesis of form-function and technique returns a unique architecture based on the principles of modernity, such as: the free plan (single room 250 meters long and 30 meters wide), the free and transparent facade (160 meters), the experimentation with materials and techniques based on the logic of optimizing the form-structure relationship that returns an innovative language, the adherence of interior spaces to the need for flexibility of the production cycle. An online petition with a request for rapid reactivation immediately started the process of enhancing the work in order to avoid the irreversible degradation of the reinforced concrete structure.

A subsequent appeal in 2016, signed by Docomomo Italia (Italian Association for the Documentation and Preservation of Modern Urban Buildings and Complexes) by Aipai (Italian Industrial Archaeological Heritage Association) and the Pier Luigi Nervi Project Association, was addressed to the Superintendence for Architectural and Landscape Heritage for the provinces of Brescia, Cremona, and Mantua to ask for a timely and effective protection measure. The General Directorate for Contemporary Art and Architecture and the Peripheries supported the

initiative, which was translated into a declaration of interest in November 2016, obtaining from the Ministry the affixing of a protection bond to the building complex as a "property of particularly important cultural interest.
Commissioned by PRO-GEST, designed by Massimo Narduzzo and Giuseppe Ruscica with CREA:RE, the rehabilitation of the Burgo Paper Mill was awarded the Docomomo Rehabilitation Award 2021 in the Sustained uses category, as an exemplary renovation that introduces contemporary standards of safety, sustainability and improved technologies while maintaining the buildings' function and identity. However, it remains an exceptional case in which the original function is repurposed.
There is no doubt that the rich production of documents has certainly enabled current planners to rebuild 'piece by piece' the process from the conception to the execution of the work, right down to the transformations undergone in the management phase. In fact, the interpretations that contemporary design has given in recent years to the industrial pre-existence are various, more or less aimed at exalting the aesthetic values expressed in the forms and types of artifacts.
To cite an altogether different intervention, with an original design approach aimed at highlighting the contrast between the new and the pre-existing on an unrestricted factory, one must mention the Fondazione Prada in Milan. Rem Koolhaas has in this case transformed a distillery dating back to the first decade of the last century into a lively multipurpose center through an articulate architectural configuration.
The Oma studio's guiding line, Koolhaas clearly explains: "The Foundation is not a conservation project, and it is not new architecture. Two conditions that are usually kept separate here confront each other in a state of permanent interaction that offers a set of fragments that does not coagulate into a single image, nor does it allow one part to dominate the others" (Koolhaas, 2005). Alongside the seven existing buildings, the project adds three new structures that highlight the change: Museum, Cinema, and Tower, dedicated respectively to temporary exhibitions,

Fig. 5. Ex ILVA, Bagnoli, Napoli (Paola Ascione, 2023).

multimedia auditorium, and a permanent ten-storey exhibition space for the Foundation's collection and activities.
This is an attractive hub that fits into one of the urban transformation areas of the Milanese suburbs, within a broader vision of city development that is substantially changing the characters of the urban landscape.

Post-industrial parks vs. industrial landscapes
Examples of neighborhoods that have become places of degradation and social marginalization as a result of the industrial crisis now transformed into centers of city development and rebirth are not uncommon. It happened in Liverpool and Manchester, it is happening for sites such as Ivrea, an experimental laboratory for Italian twentieth-century architecture, which are recognized as a heritage resource capable, as in the past but in absolutely different terms, of conferring high added value to urban transformation interventions.

Today we are aware of the disruptive impact of industry on the ecosystem, the industrial landscape devoid of the motive that had dictated its construction, tends to be assumed in its aesthetic dimension. Rethinking brownfields in terms of landscape is a direction that has already been clearly expressed in interventions to redevelop large former industrial basins such as the Ruhr and Lusatia.

In some examples of the redevelopment of industrial areas, nature seems to take over the remnants of the plants. However, the aestheticizing vision of ruins, suspended between a distant past and a near future, tends to take them on as sculptures, high-impact representative fragments charged with the representation of what they were.

Hard to generalize, the industrial landscape is multifaceted, just as industrial architecture is multifaceted. Different production activities have connoted landscapes of mines, textile industries, steel mills. What we see is just the latest outcome of a continuous evolution dictated by technological development: "The valorization of an industrial landscape must not forget that what is presented to our eyes is nothing more than the last frame of that invisible film that shows the history of a factory" (Preite, 2018). Recently, some interesting criticisms have been raised against a certain idea of the post-industrial park. Michael Friedrich writes that "landscape architects have created popular public spaces by superimposing the pastoral (wildflowers, water features) over the post-industrial (steel, concrete), evoking nostalgia for a lost urban wilderness." Almost as if the juxtaposition of wilderness and the wreckage of industrial icons showed the unraveling of an anthropocentric vision represented by the ruined factories, which reverses the human-nature relationship by showing the fragilities of the human environment against the strength of the aestheticized wilderness that makes the post-industrial landscape uncanny, sublime in its extremes (Bodei, 2018). But even in these cases we find the exceptions that testify to a creativity in reinterpreting those places to the measure of today's society. Intervention where places do not lose the memory of a past civilization, with all that technological progress has generated, for better or worse.

The complete erasure of industrial 'archaeologies' may diminish the meaning they hold for local communities. 'Post-industrial' parks can serve as reminders of a past but only if they are also economic generators of communities can they have a future. In this sense, the idea of reclaiming open spaces and artifacts by dedicating them to temporary uses in projection of projects to be defined in the long term, allows for gradual operation on the ground. A reactivation phase that would allow, on the one hand, a direct confrontation with stakeholders to measure the real possibilities of introducing new functions, even permanent ones, and on the other, the search for appropriate forms of financing and management without which these places will be abandoned to an uncertain and nebulous fate.

References

Aa.Vv. (2005). *Van Nelle. Monument in progress*. Rotterdam: Utgeverij De Hef.

Banham, R. (1986). *A concrete Atlantis. U.S. Industrial building and european modern architecture 1900-1925*. Cambridge, Mass.: MIT Press.

Bodei, R. (2008). *Paesaggi sublimi. Gli uomini davanti alla natura selvaggia*. Milano: Bompiani.

Convenzione Faro, (2005). <https://ufficiostudi.beniculturali.it/mibac/multimedia/UfficioStudi/documents/1362477547947_Convenzione_di_Faro.pdf> (accessed 24 may 2023).

Corti, B. (1991). Archeologia Industriale. In *Enciclopedia Italiana, V Appendice*. <https://www.treccani.it/enciclopedia/archeologia-industriale_res-27358d04-87ea-11dc-8e9d-0016357eee51_(Enciclopedia-Italiana)/> (accessed 2 may 2024).

Koolhaas, R. (2005). <https://www.domusweb.it/it/architettura/2015/05/11/fondazione_prada_a_milano.html> (accessed 2 May 2024).

Preite, M. (2018). Paesaggi industriali e patrimonio Unesco. <https://www.letture.org/paesaggi-industriali-e-patrimonio-unesco-massimo-preite> (accessed 2 may 2024).

The Massachusetts Institute of Technology, trad. it. Banham R. (1990). L'Atlantide di cemento. Edifici industriali americani e architettura moderna europea 1900-1925. Bari: Laterza.

Zorgno, A.M. (1998). Patrimonio industriale e modernità. In *docomomo Italia giornale*, No. 4, p. 1.

Transitory uses and transition processes of vacant buildings for inclusive and circular city

Orfina Fatigato

Introduction

Within the framework delineated by the Blended intensive programme *Industrial Archaeology. European approach to recovery productive memory*, the present article seeks to convey an experience originating in Naples. This engagement unfolded within the context of an interesting initiative showcased at the CA23 Plural Territories Architecture Festival, held alternately in April in Naples and in October in Paris. This platform offered the opportunity to explore the more general topic of transitional uses in urban regeneration processes. At the core of this research lies an examination of the intrinsic value conferred by transitional uses to processes of urban regeneration and transformation. Transitional uses function as pivotal catalysts, instigating enduring and multifaceted transformations that necessitate a re-evaluation of the spatial and temporal dimensions inherent in urban development. Methodologically, this inquiry necessitates a deliberate consideration of how design processes can assimilate temporal dynamics, thereby facilitating the evolution of project, engendering nuanced engagements with a heterogeneous array of stakeholders.

The concept of transitioning disused spaces towards an inclusive and circular city encapsulates the thematic focus of this article. Transition inherently acknowledges that projects materialize within preexisting contexts, exerting a reciprocal influence on these contexts over time as spatial and temporal dimensions converge and interplay. Converging

events, both anticipated and unforeseen, coalesce to propel these transition processes forward, shaping the trajectory of urban development.
This paradigm of an inclusive and circular city advocates for reactivation processes that embrace innovative housing models and nurture socially, economically, and ecologically sustainable urban living paradigms.

The living lab "Living in the City in Transition": an experiment in Naples

Reflective attention toward the experimentation of transitory uses has now extended to Italian municipalities, where several administrations are actively engaged in leveraging temporary (and/or transitory) uses as a strategic mechanism for revitalizing publicly-owned buildings that have fallen into disuse.
The legislative recognition of transitory uses was initially introduced as an amendment to Article 23 of Presidential Decree 380/2001 and subsequently adopted by various regions, including Lombardy, Emilia Romagna, and Campania itself. Notably, Campania enacted Regional Law 13 of 2022, titled 'Provisions on building simplification, urban regeneration, and the redevelopment of the existing building stock.' These legislative measures constitute a series of regulatory and procedural frameworks aimed at legitimizing the temporary reuse of buildings and abandoned areas. They also provide flexibility for alternative uses beyond those originally envisioned by the existing regulatory framework.
The city of Naples, by approving *Delibera di Giunta Comunale n. 30/2022* "Draft Convention for the Regulation of Temporary Uses for Public Spaces and Publicly Owned Properties," aimed to promote processes for the temporary use of public assets. However, this project currently finds limited concrete projects, partly due to the difficulty of collaboration among different offices required for a temporary reuse project.
Within the framework of the CA23 Territori Plurali Architecture Festival, held in various locations in Campania and Paris in 2023, the theme of temporary uses was addressed through the work of one of the six Living Labs of the Festival. In particular, in Naples, in collaboration with the

Fig. 1. CA23 Architecture Festival CA23 Plural Territories, Living Lab Inhabiting the City in Transition (source: Living Lab photos).

Department of Architecture of the University Federico II and ENSA Paris Malaquais, the Living Lab "Living in the City in Transition: Evolutionary Projects for the Reuse of Large Urban Containers" was held, focusing on the theme of temporary uses, starting from the significant regulatory changes implemented by the Campania Region and the Municipality of Naples (Fig. 1).

The living lab was conceived and structured as a collective laboratory that examined the processes of regeneration of some large disused containers in the city of Naples, starting from the activation of possible temporary uses. Together, they discussed the co-creation of innovative programs, new forms of accommodation to inhabit these spaces again, proposing open and incremental strategies over time.

Co-creation was systematically explored through the engagement of participants spanning diverse backgrounds, including architecture students, local community associations, and interested residents. This collaborative endeavor sought to innovate novel programs aimed at fostering communal living arrangements. The strategies devised were characterized by their openness and incremental nature, emphasizing adaptability and evolution over time. During the LL, the specificities, 'stories' and potentialities of some disused buildings that, at different scales, populate the urban territory of Naples were explored.

Fig. 2. Exhibition Cubic Metres in Transition curated by Orfina Fatigato and Gianluigi Freda, ex Chiesa dei Santi Demetrio e Bonifacio, Naples, 17 - 28 April 2023 (Photos by Mario Ferrara).

Living Lab participants and communities of inhabitants together with architects, photographers, artists, students and university lecturers questioned the value of these containers as 'places of the ignored possible' (Fig. 2).
Integrated projects were tested on some of the numerous abandoned buildings that dot the urban landscape of the city of Naples, returning metaprocesses aimed at demonstrating the feasibility and potential that can be activated through the experimentation of transitional uses. The integrated methodological approach started from the elaboration of an interactive and expandable map of the disused urban heritage, of public and private property, of the East Naples area.
An interesting observation to emerge from the mapping work, despite its relatively short duration, is the large number of empty and abandoned buildings in the East Naples area. Making use of available resources, the mapping work has documented a substantial volume of empty cubic metres within approximately one third of the urban landscape of Naples. The decision to quantify space in terms of cubic metres, rather than square metres, arose from the desire to emphasise the capacity of these abandoned volumes to be inhabited.
Throughout the Living Lab activities, in-depth discussions were held on various identified urban structures. Accompanying these discussions were a series of photographs meticulously captured by architect Mario Ferrara. This artistic representation induces the contemplation of the

Fig. 3. Map of vacant buildings East Naples for Living Lab Living the city in transition (source: Living Lab photos).

bare and monumental presence of these buildings, of various sizes, sometimes very imposing.

Among the buildings mapped is the Corradini factory, an industrial landmark emblematic of Naples' rich architectural heritage. The photograph returned by Mario Ferrara effectively conveys the diverse nature of these architectural ruins, each of which carries its own historical significance and narrative. The juxtaposition of emblematic buildings, such as the Corradini factory, alongside more recent postmodern structures underlines the complex interaction between architectural preservation and urban revitalisation in contemporary urban landscapes (Fig. 3).

There are many examples throughout Europe, and partly in Italy, of empty buildings and spaces being used to host social and cultural experimentation. Re-inhabiting these empty spaces represents an act of emancipation from the constraints imposed by the capitalist urban system. The failures of the capitalist urban model are witnessed by

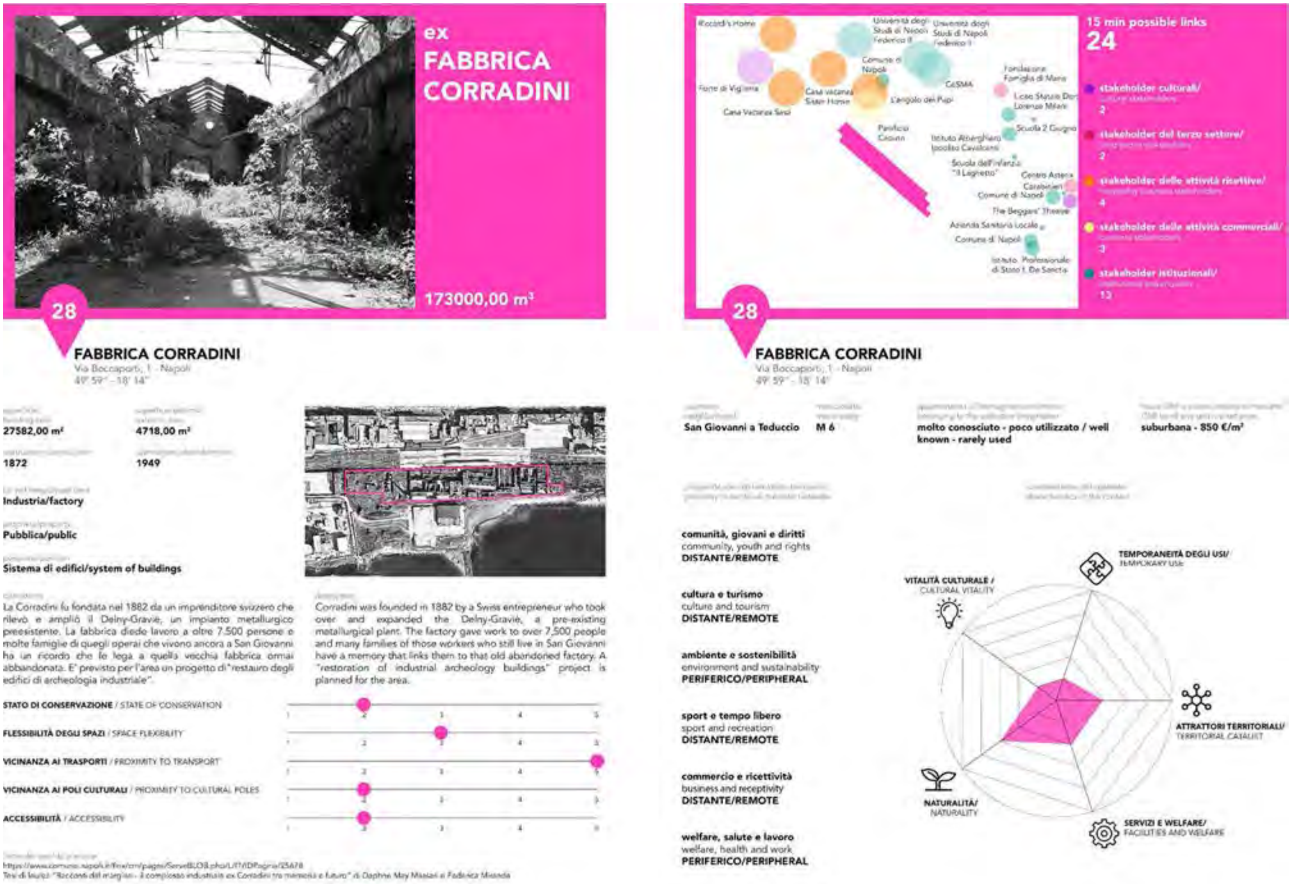


Fig. 4. Example of analytical interpretative map of vacant buildings in Naples: ex Corradini factory (elaborated during the Living Lab Inhabiting the City in Transition).

the proliferation of disused, once productive sites scattered across the territories.

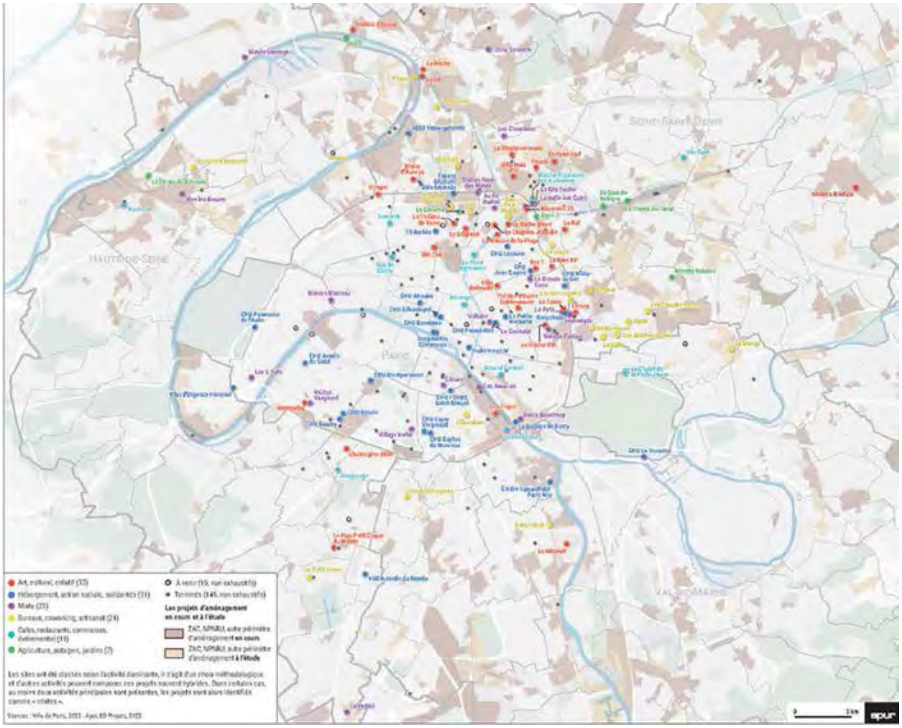
Marc Augé writes in *Le temps en ruines* (2002): "Urban planning and architecture have always been intertwined with power and politics, and the current forms of the contemporary city - which multiply the areas of poverty, the fields and by-products of uncontrolled urban development - underline the cynical evidence of this exploitation of the land". For Augé, these abandoned spaces embody a sense of time, evoking past memories and potential futures without attempting to summarise or conclude their narratives in the illusion of knowledge and beauty. Instead of mere places, these ruins symbolise the beauty of what could have been, what has been and what is yet to come. They evoke a vision of a possible future in which experimentation with new forms and ways of living in the contemporary city finds expression in these buildings.

Through the mapping of empty buildings in East Naples drawn up during the Festival Territori plurali - which was not exhaustive, partial and carried out in the short time available during the LL's activities - approximately ninety buildings were in any case identified, for each of which a multi-criteria interpretation sheet was subsequently drawn up (Fig. 4).

The buildings were first of all divided into three groups according to the square metres surveyed. The cards were structured in two distinct parts, side A and side B. The front (side A) was conceived as a sort of identity card for the building in which historical, dimensional, and typological information on the building was reported, flanked by the identification of some useful indicators in the perspective of the transitional reuse of the analysed building such as: the state of conservation, flexibility of the spaces, proximity to transport, proximity to cultural poles, accessibility. On the back side (side B) of the sheet, possible networks at different scales were indicated, into which the building could be grafted, starting from its reuse: of stakeholders (cultural, institutional, third sector), of receptive activities, of commercial activities, intercepted within a radius of about 15 minutes' walk from the building (Fig. 5).

Various polarities overlap these "white constellations" of empty buildings, resembling stars of different colors, representing the various activities of the third sector and active realities within the territories. The overlap between the maps of these different constellations shows how abandoned buildings are often located within vibrant and culturally and economically active contexts. These are not just isolated structures, but rather spaces integrated into lively urban environments.

Fig. 5. Cartography France Tiers Lieux @ www.francetierslieux.fr.



Transitory uses and third places in urban regeneration project in France

In France, over the last decade, the reuse of abandoned spaces has occurred through the activation of transitional uses. This tool for urban regeneration has transitioned from a conceptual framework to a widespread practice, even at the institutional level. Regulation for transitional uses has been formalized, and currently, many urban transformation projects include a structured initial phase focused on transitional uses. Interdisciplinary design teams are tasked, through tender or competition procedures, with managing the temporary utilization of buildings and large abandoned areas within urban regeneration processes.

Central to this evolution was the introduction of the law on freedom of creation for architecture and heritage, notably Article 88, which sanctioned the experimentation with transitional uses in abandoned spaces for a defined period. This legislative milestone marked a shift from a culture of regulatory norms to one focused on objectives. It provided a framework for activating transitional uses while upholding principles of inclusivity,

The regulatory framework surrounding transitional uses in France exemplifies a balanced approach that prioritizes experimentation, innovation, and community engagement while navigating regulatory constraints. It underscores the transformative potential of temporary interventions in shaping more inclusive, sustainable, and vibrant urban environments.

Coinciding with these developments in France, a significant exhibition titled "Infinite Places" was showcased at the Venice Biennale. Presented in the French Pavilion, the exhibition narrated the stories of ten places defined as ecological and solidarity collaborative pioneers.

These ten places, each with their specific nature, often involve experiments in temporary use and highlight the notion of co-management involving multiple actors. These spaces are all akin to "third places." Coined by sociologist Holden Berg in the 1990s, the term refers to hybrid spaces that distinguish themselves from traditional living or working environments; Bouret further developed this concept, emphasizing its experimental nature.

These third places serve as dynamic environments where living, working, and learning intersect, facilitating experimentation and innovation. In France, many large abandoned buildings utilized for transitional uses are identified as third places, embodying the ethos of experimentation and community engagement (Fig. 6).

Certainly, the principles around which the concept of third places revolves can be encapsulated in key words that signify collaboration, experimentation, incrementality, and indeterminacy.

Collaboration is integral to the ethos of third places, characterized by multifaceted cooperation among diverse actors such as cooperatives,

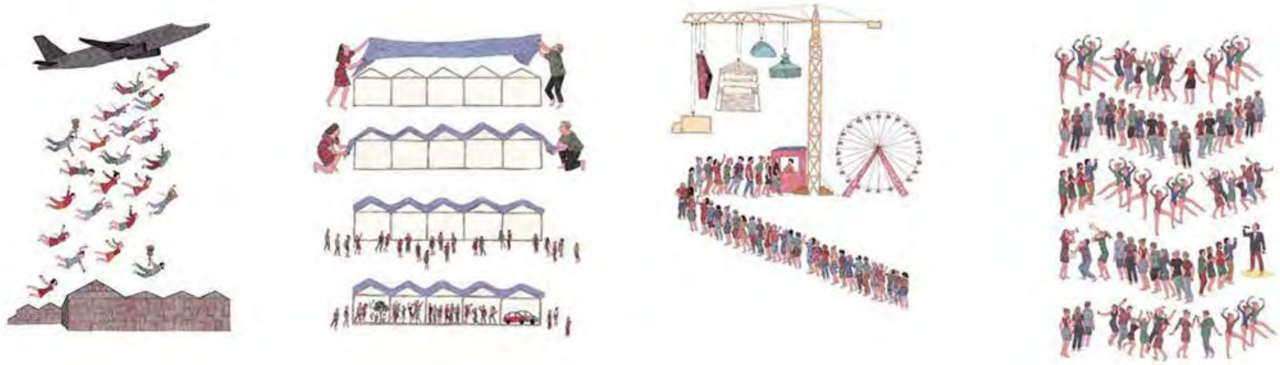


Fig. 6. Processuality of project, credits Agence Construire, Patrick Bouchain et Loic Julienne.

multidisciplinary groups, citizens, and economic stakeholders. Unlike spaces managed by singular entities, third places thrive on collaborative efforts, fostering a sense of community ownership and engagement.
Experimentation lies at the heart of third places, epitomized by the motto of groups like Plateau Urban, which advocates for putting creativity at the forefront. These spaces serve as laboratories for testing ideas, concepts, and activities, continuously evolving based on feedback and outcomes.
Incrementality underscores the iterative nature of third place projects, where developments unfold gradually over time. Collaboration not only shapes the initial configuration of these spaces but also influences their ongoing adaptation and transformation. This principle emphasizes the importance of flexibility, adaptability, and responsiveness to evolving needs and dynamics (Fig. 7).
Indeterminacy, as advocated by Patrick Bouchain, embraces uncertainty and spontaneity within third places. Bouchain's notion of the "architecture of disagreement" highlights the value of creating spaces that challenge preconceived notions and allow for unexpected encounters and experiences. This principle encourages designers and facilitators to embrace variability and embrace the unforeseen, fostering a culture of openness, curiosity, and innovation.
Third places embody a dynamic interplay of collaboration,

Fig. 7. Project of urbanisme transitoire Le Grands Voisins (Parigi 2012-2020) (source: www.lesgrandsvoisins.org).

experimentation, incrementality, and indeterminacy, creating vibrant, inclusive, and adaptive environments that resonate with the evolving needs and aspirations of their users and communities.

The Le Grands Voisins project in Paris stands as a significant example of successful implementation of transitional uses within a complex urban setting. Formerly an abandoned hospital comprised of multiple pavilions, this initiative has paved the way for various interdisciplinary groups in France to explore the potential of managing transitory uses in a large-scale, multifaceted environment over a period of 10 years (Fig. 8).

A notable aspect of the Le Grands Voisins project is its emphasis on hospitality: The project initially repurposed spaces within the hospital for temporary accommodation of asylum seekers, while concurrently hosting workshop activities facilitated by other associations. This approach not only provided essential support to asylum seekers but also fostered a sense of autonomy and respect within the shared spaces.

As the project evolved, additional connections and relationships were established, leading to the introduction of initiatives such as a restaurant specializing in migrant cuisine. This integration not only offered employment opportunities to asylum seekers but also contributed to the project's economic sustainability. Furthermore, the project attracted artists and other creatives who leased workshop spaces within the premises, generating revenue that supported both economic and non-economic activities.

This intricate economic ecosystem underscores the project's commitment to achieving a circular and inclusive urban environment. By balancing

Fig. 8. Césure, project of transitory uses managed by Plateau urbain (Paris) (photos by O. Fatigato).

revenue-generating activities with socially impactful initiatives, the project demonstrates a holistic approach to urban regeneration that prioritizes both economic viability and social well-being. Moreover, the project's long-term duration allowed for the gradual evolution of activities and relationships, further enriching the fabric of the community and fostering a sense of belonging among its participants.

The Cesure project offers another compelling example of ongoing transitional use within urban spaces. Located in a former Sorbonne building in Paris, this initiative represents an active endeavor to repurpose the space while awaiting renovation. The Sorbonne company, responsible for managing the building, initiated a tender process to enable a transitional use of the premises for a period of seven years. This transitional phase serves not only to activate the building but also to gather valuable insights and feedback that can inform future renovation plans and potential alternative uses (Fig. 9). Transitional uses like Cesure highlight the diverse objectives that can drive such initiatives. Beyond merely filling empty spaces, these projects serve as platforms for experimentation, information gathering, and even cost-saving measures for property owners. By repurposing vacant buildings, even on a temporary basis, owners can mitigate the financial burden of maintenance while generating interest from potential economic stakeholders.

The complexity of transitional use projects underscores the intricate interplay between spatial, temporal, and economic dimensions. Understanding and engaging with these processes are crucial steps toward realizing the vision of an inclusive, contemporary city. By embracing innovative approaches to urban regeneration, such as transitional use projects like Cesure, cities can unlock the latent potential of their built environments while fostering dynamic and vibrant communities.

Third places are interesting, as they serve as pivotal reservoirs for social capital accumulation and experimental urban practices (Fig. 10). In furtherance of this discourse, a thorough analysis conducted by the Atelier Parisien d'Urbanisme underscores the multifaceted nature of groups engaged in transitional urbanism across France, including Communa, Plateau Urbain, and Soal Mar Camp. Despite their varied approaches, these groups collectively assume the role of real estate actors, orchestrating the management of temporary spaces. Their endeavors not only augment the tangible value of real estate assets but also address broader societal concerns pertaining to urban space vacant utilization.

There are many activities within these transitional spaces, ranging from

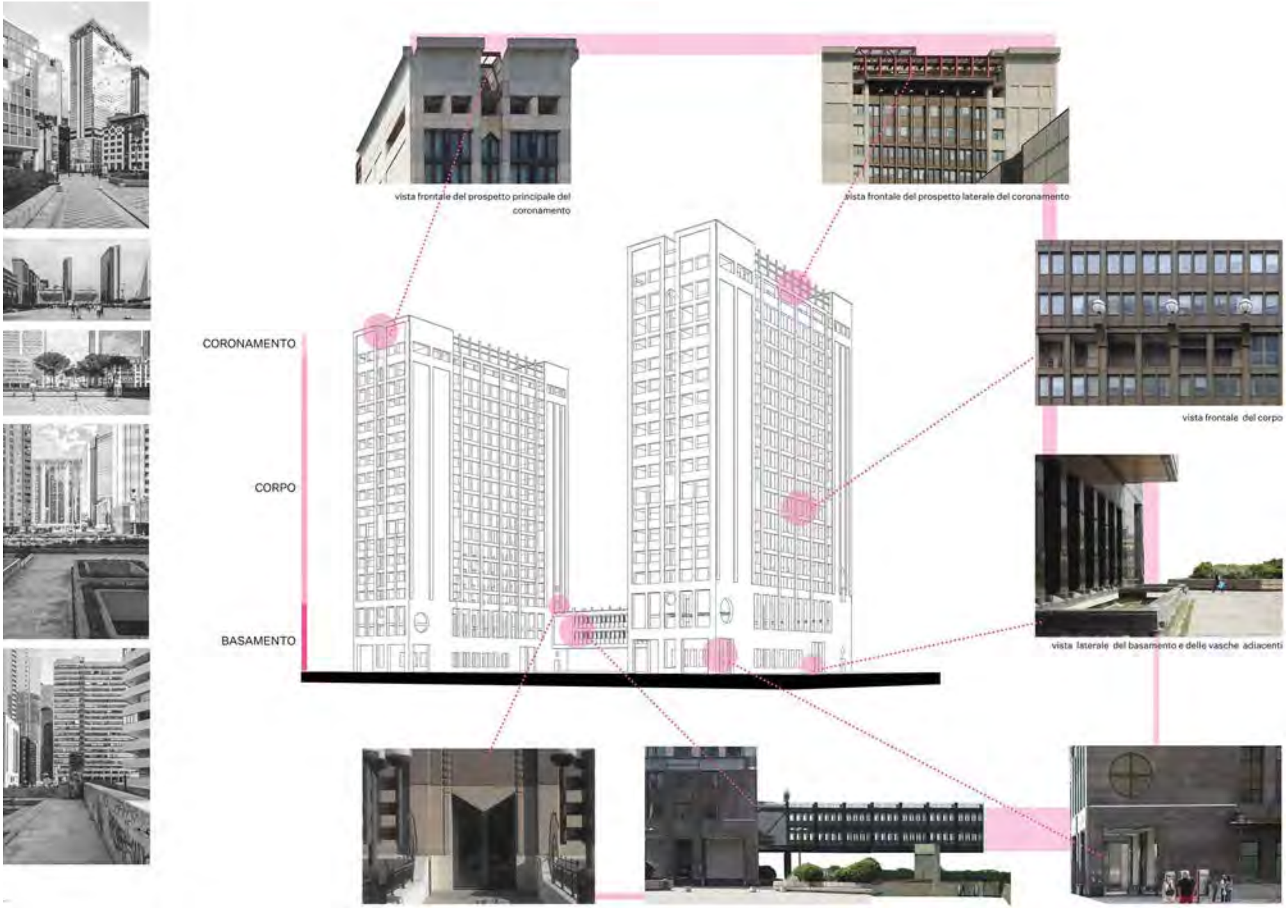


Fig. 9. Studies for the design of transitory uses for the Banco di Napoli building, Centro Direzionale Naples. (Students of the Design Laboratory 2022 -2023 CdS MAPA, Unina).

cultural engagement to educational initiatives. Moreover, these groups experiment with different economic models to support their efforts, emblematic of their innovative stance towards urban development and community empowerment. Through an interdisciplinary lens, such studies contribute invaluable insights into the adaptive mechanisms underlying transitional urbanism, illuminating pathways for sustainable urban regeneration and inclusive community development.

Projects of transitory uses in Naples: experimental metaprojects

During the Living Lab (Festival of Architecture CA23 Plural Territories), the specificities, "stories," and potential of some disused buildings that populate the urban territory of Naples were explored at different scales. Living Lab participants and community members, along with architects, photographers, artists, students, and university professors, questioned the value of these containers as 'places of possibility.'

Among the explored vacant buildings, there is one situated on Poggio Reale Street (Fig. 11), initially designated for postal services before being abandoned. Adjacent to still-occupied residential towers, this significant structure now stands deserted. Preliminary calculations reveal that substantial expenses have been incurred over the past two decades solely to maintain the closed facility, encompassing security costs and minimal maintenance expenditures. Recognizing the financial burden of abandonment underscores the urgent need to explore alternative management approaches. Experimental trials of temporary management strategies have been conducted to showcase how they could lead to significant cost savings for property owners, while also fostering opportunities for experimentation and revitalization.

Similarly, the Towers of the former Banco di Napoli (Fig. 12), located within the business district of Naples, represent another intriguing case study. These towers, designed by architect N. Pagliara, now stand as vast voids amidst a landscape of partially occupied and degraded buildings. Through visual aids such as videos and presentations, proposed transformation projects for these towers aim to demonstrate the potential for adaptive reuse and urban revitalization that could arise from their transient utilization.

The approach employed in both case studies was based on a thorough examination of contextual conditions. This involved identifying key areas and spaces suitable for activating temporary uses, aligning overarching goals with specific actions through a decision-making framework. Each action was meticulously planned, considering factors such as location, required resources, involved stakeholders, and desired impact. A crucial

Fig. 10. The cost of emptiness, extract from Simona Capaldo's thesis project (tutor O. Fatigato, M. Cerreta, HALL - Hemicycal Agrifood Living Lab" in the East of Naples.

aspect of the approach was the construction of an incremental program for interventions within the building spaces.

Another experimental project on temporary uses and incremental development was undertaken as part of Simona Capaldo's thesis (supervised by O. Fatigato and M. Cerreta). The project focused on a former fire station dating back to the late 19th century, situated within an intriguing urban block. Methodologically, the project evolved by intersecting design methods with appraisal and evaluation techniques. The starting point of the work was an assessment of the cost of the building's decommissioning during the period of abandonment (eight years).

An essential aspect of the project has involved archival research, aiming to restore dignity to these empty buildings by uncovering their rich history. These buildings, even though abandoned, bear witness to past lives, captured in photographs and memories, underscoring the need to recognize them as integral parts of our urban fabric. This archival work serves to testify to the vibrant life that once thrived around these structures.

The urban complex, with a semi-circular building from the mid-nineteenth century alongside industrial factories, reflects the area's evolution over time. Despite the current state of abandonment, the project has proposed a transformative approach, envisioning a space dedicated to new forms of production. Situated amidst hilly landscapes near Capodimonte and the botanical garden, the area is nestled among dense urban fabrics, fragments of resilient urban agriculture, and third landscapes of abandonment. The project, titled "Agrifood Living Lab," focuses on the transition process of the urban block towards new forms of agriculture in the eastern area of Naples. In the thesis project, an urban strategy was implemented to revitalize the block, starting with the creation of a bike path to reconnect the abandoned areas.

Further interventions made the introverted walls of the block more porous and permeable, improving connectivity with the square in front of the semi-circular building. This attention to transversality and permeability extended to the creation of new internal courtyards, promoting public spaces conducive to the experimental and productive aspects of urban agriculture.

The process over time is structured into three phases: the seeding phase - initial investment with limited economic profitability; the economically more profitable growth phase, and the harvesting phase. Each action is outlined in different spatial phases involving various actors, visualized from economic actors to privileged interlocutors and hypothetical investors.

The project axonometry (Fig. 13) portrays the evolution of the project over time, including the construction of a new volume that expands over time. The design of the new system between the ground floors of the volumes expresses the desire to create porous spaces within the block, connecting the historic building, the industrial hangars, and the new construction.

The intervention involves the conservation and transformation of the industrial warehouses: one into a market space with movable volumes for indoor-outdoor use, and the other used for hydroponic cultivation. The newly constructed building aims to accommodate researchers and features spaces for culinary experimentation, aligning with the growing

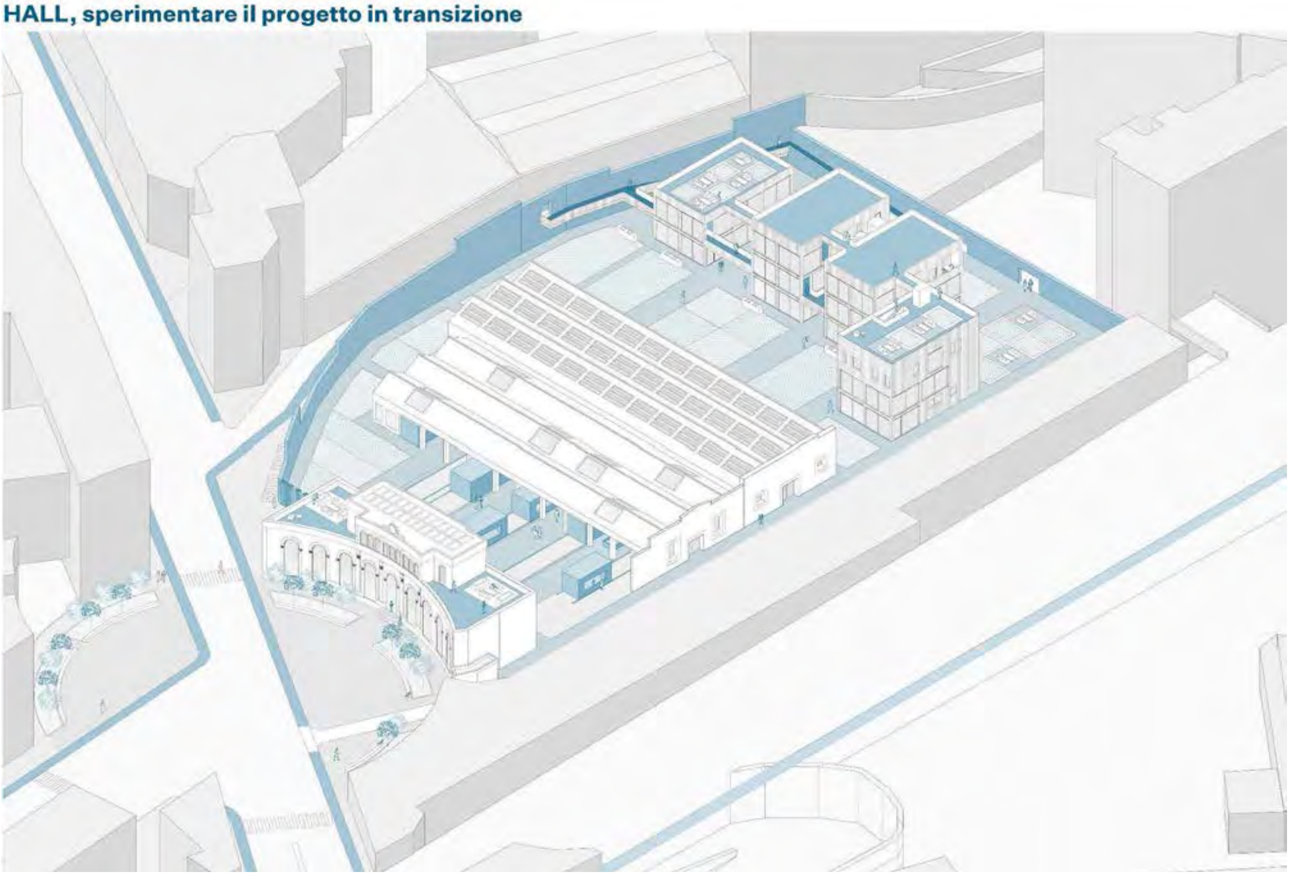


Fig. 11. Axonometry of Simona Capaldo's thesis project HALL - Hemicycal Agrifood Living Lab" in the East of Naples.

interest in agricultural productivity and food culture in Naples. Alternative scenarios proposed by the thesis explore other potential outcomes. These scenarios reveal the economic value inherent in disuse and abandonment, highlighting the multiple dimensions (cultural, economic, social, spatial) involved in urban regeneration projects.

Conclusion

In conclusion, the key concepts discussed are underscored, shedding light on the theme of transitory uses and the intricate relationship between temporary and transitory interventions. The term “transitory” denotes transformational actions that occur in a moment but are embedded within a longer-term temporal process, akin to the initial pieces of a system that must evolve and adapt over time. Conversely, “temporary” implies a use that may be ephemeral but remains essential to consider.

Examining the dichotomy between the public and private spheres, it becomes crucial to explore how they intersect within complex processes; the analysed case studies prompt reflection on the distinction between single management systems and co-management systems that are more suitable for addressing the regeneration process. From a design perspective, it is indispensable to distinguish the theme of space transformation through transitory uses from the repetitive adoption of a temporary aesthetic. Instead, attention should focus on understanding the evolutionary nature of spatial transformations.

Through design experiments of multiple case studies, we considered desirable project actions to ‘reclaim’ spaces in disused buildings, which often appear uninviting due to their alienating scale or evident obsolescence. Simultaneously, we focused on the potential for proposals to evolve as a necessary condition for space activation.

The relationships and connections between space users are in constant flux and transformation. It’s as if the design of these experimental spaces must remain partly “open” to evolve, change, and adapt over time in harmony with the people and the “living” world (Clément, 2006) that inhabit them.

References

Agamben, G. (2018). *Abitare e costruire*. Macerata: Quodlibet.

Augé, M. (2002). *Le temps en ruine*. Paris: Galilee.

Berger, A. (2006). *Drosscape: Wasting Land in Urban America*. Princeton Architectural.

Boano, C. (2020). *Progetto minore. alla ricerca della minorità nel progetto urbanistico ed architettonico*. Siracusa: Letteraventidue.

CHAPTER 1

Borges, J. L. (2020). *Storia dell'eternità*. Milano: Adelphi.

Bouchain, P. (2006). *Construire autrement: comment faire?*. Arles: Actes Sud.

Clément, G. (2006). *Une écologie humaniste.* Avignon: Aubanel Editeur.

Donadieu P., & Mazas E. (2002). *Des mots de paysage et de jardin*. Dijon: Educagri.

Encore Heureux Architectes (2018). *Lieux infinis* : *construire des bâtiments ou des lieux ?* Paris: B42.

Sendra, P., & Sennett, R. (2023). *Progettare il disordine*. Roma: Treccani.

Sennett, R. (2018). *Costruire e abitare. etica per la città*. Milano: Feltrinelli.

Lacy, P., Long, J., & Spindler, W. (2020). *The Circular Economy Handbook: Realizing the Circular Advantage*. London: Palgrave Macmillan.

Pasqui, G. (2019). Futuri anteriori: il tempo del progetto. In *Rivista di estetica, the science of future*. Promises and previsions in architecture and philosophy, No. 71, pp. 50-56.

Robiglio, M. (2017). *RE-USE, 20 American Stories of Adaptive Reuse. A toolkit for post-industrial cities.* Berlin: Jovis Verlag.

Living the spaces of post-production: design scenarios for Bagnoli

Giovanni Multari, Margherita Maurea, Paola Ascione, Vincenzo Gioffrè

"The existing" as potentially structuring material for the architectural design

More than other places, industrial abandoned areas appear suspended, where time, although passed by, manifests itself through present permanencies, in a condition between past and present, between the loss of values and the immense potential they offer to the contemporary city. In this context, the relationship between architecture and time emerges as a crucial interpretative key to address the issue of productive memory recovery.
The project for the regeneration of these areas is required to balance the permanence of identity elements with the necessity of adaptation and variation. It is essential to start from the identification of the intrinsic identity of these spaces, considering their historical, cultural, and social characteristics. The transformation process must be guided by the specific needs and requirements of the local community, in constant dialogue with the surrounding context, through gradual steps and actions that allow for continuous evaluation of the outcome.
In the broader context of transformation processes in the peripheral areas of contemporary cities, there emerges the need for an inclusive approach that sees architectural project not only as a means to transform physical spaces, but also as a catalyst to activate sociocultural processes that can sustain transformations over time.
The thesis studio is configured as a valuable moment to organize and

structure design research dedicated to the regeneration of abandoned sites, with the aim of redefining how public space is used. The methodology adopted explores the possibility of interpreting "the existing" as potentially structuring material for the architectural project to re-signify these areas, introducing strategies that can be replicated in similar contexts.
A tangible example of these challenges is the former Bagnoli steel plant, located on the western suburbs of Naples (Fig. 1).
Founded in 1910, the plant experienced significant growth until World War II, becoming a key industrial hub in southern Italy but simultaneously causing severe environmental damage.
The blast furnace, towers, and industrial spills, directed into the coastal sea, made it one of the most polluted places in the South of Italy.
With the closure of the plants in 1992, a long and unprofitable discussion began on the future of Bagnoli and the re-covery of the area to the point that it "[...] had become so identified with the factory that, when it disappeared, it au-tomatically became a nothing, a non-place, an absence. Above all, an absence of the future" (Rea, 2002, p. 184). Decades of confrontations are closed – finally – with the international competition "UrbaNAture" curated by Invitalia, the agency of the Ministry of Economy and Finance. A competition to transform the 250 hectares of the former in-dustrial area of Naples into one of the largest and most fascinating urban parks on an international scale.
However, despite exciting prospects, uncertainty and carelessness persist in the area, as previous plans have failed to draw sufficient resources and interest to initiate a meaningful reactivation.
There is a long waiting period expected for the new large urban park project to be implemented. Therefore, in the most immediate terms, a series of questions emerge: what actions can be taken towards final implementation? How can we take effective action on such a critical and unique site? Most importantly, can the actions we take now be in-tegrated or related to the final project?
In response to these challenges, the need emerged for a phased and

Fig. 1. Two Faces of Bagnoli: On the traces of its industrial past, the large structures emerge among the lush vegetation that is slowly reclaiming the area. A visual contrast that reflects the ongoing transition, where the industrial legacy merges with the rebirth of the landscape (photographs: A. Cherillo and C. Prezioso).

inclusive approach that actively involves the local community and enhances the existing industrial heritage.
The thesis studio was a key moment in this process, providing a space for theoretical investigation and design exper-imentation, which involved site visits, seminars with experts, making study models and graphic re-elaborations. The different stages of the process involved the knowledge of different disciplines that informed the architectural project by leading the discussion with different stakeholders, including residents, third sector organizations, academic institu-tions, associations; the definition of the urban and architectural strategies; the relationship with the existing industrial heritage, the approaches related to landscape project, up to the essential actions to manage, maintain and sustain the regenerated spaces.
The Ex-Italsider area represents a testimony to the material and intangible culture that has helped determining the landscape. It is a complex system in which nature, economy, culture, and the built environment meet and relate to each other. The regeneration of this heritage and its related values (both tangible and intangible) necessarily presup-poses a holistic approach that starts with a deep understanding of it. Knowledge, as a fundamental act, constituted the starting point for building the intentions of a design strategy, which reads "the existing" as a project issue. In this sense, the reconstruction of the levels of perception and consistency of the territory – including settlement, infra-structure, environmental, regulatory, and social aspects – emerged as the result of a careful reading practice aimed at tracing the demand for transformation. The multiplicity of views made possible the construction of diversified but coherent design scenarios, which constitute – as a whole – a macro-strategy of transformation that, by drawing on two absolutely crucial aspects for the regeneration of Bagnoli, the landscape and the industrial heritage, reflects on the idea of "an intermediate time" between the area's current condition of suspension (Fig. 2) and the realization of the future urban park. In this perspective, the output of the research is the intermediate time plan named "Living the spaces of post-production" (Fig. 3), which proposes an incremental series of design actions aimed at

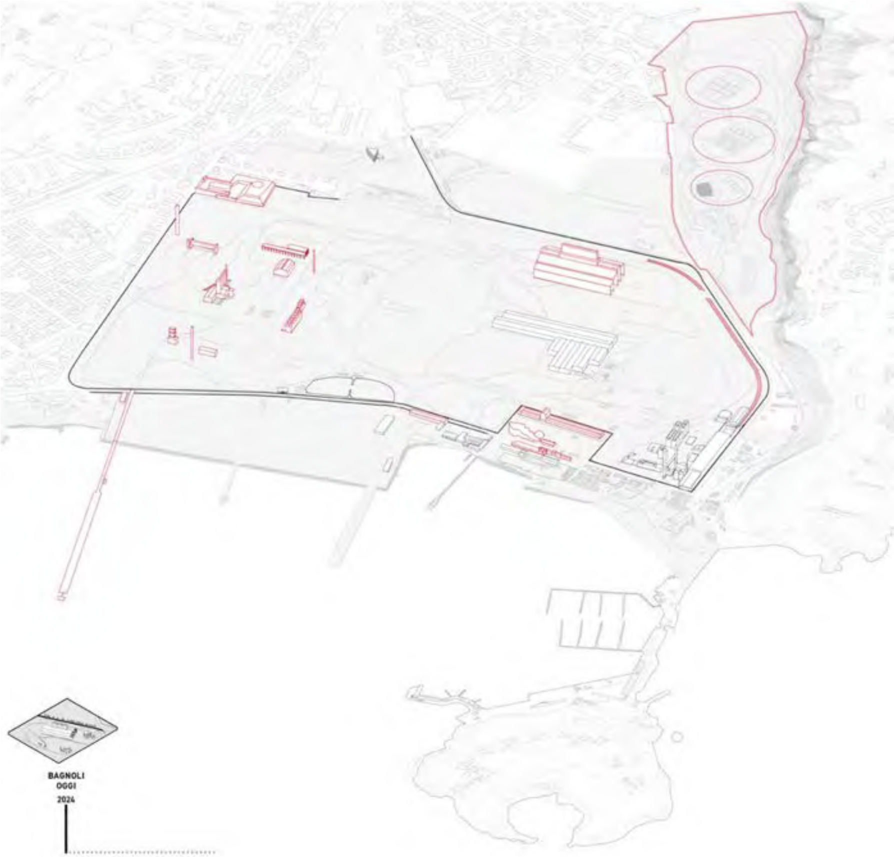


Fig. 2. Axonometric diagram illustrating the current condition of the Bagnoli area, highlighting the boundary delineated by the fence wall separating the former industrial area from the surrounding neighborhood (drawing: A. Cherillo and C. Prezioso).

engaging the community and gradually regenerating the area, to relate, in a further step, to what will be the final project (Fig. 4).
This approach aims not only to physically transform the space, but also to promote a shared collective vision and es-tablish an operational model that can be replicated in other similar settings. The goal is to provide the community with new ways to living for previously abandoned or neglected spaces, while the large urban park is being realized.
The urge to start from the "places of post-production" imposes

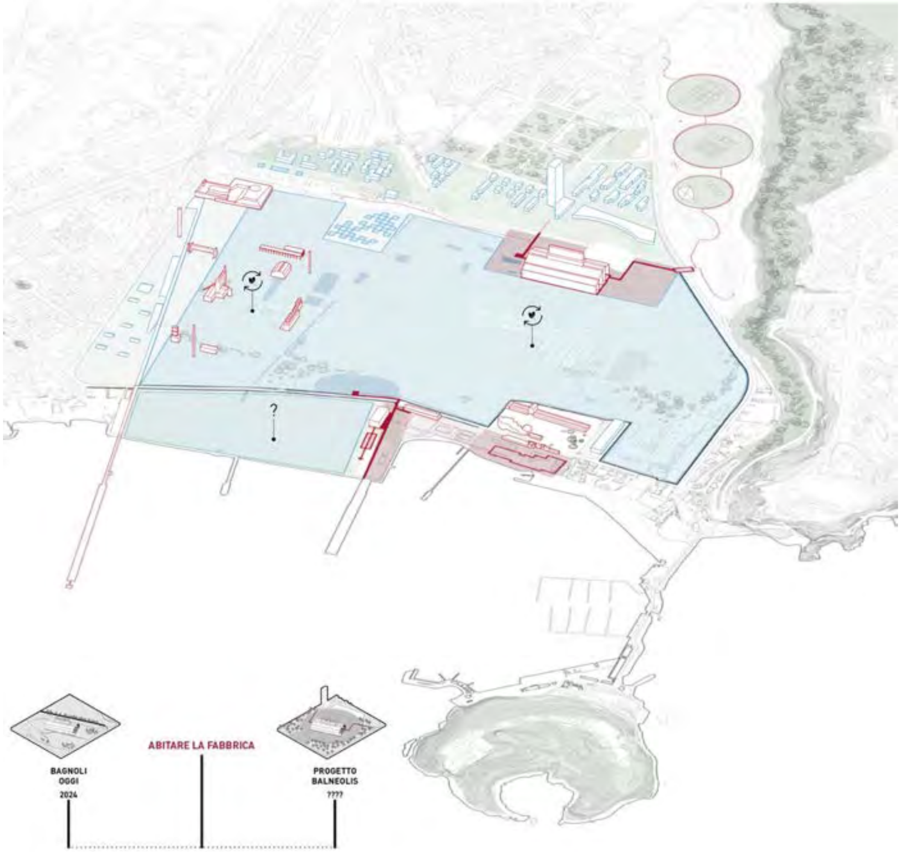


Fig. 3. Axonometric diagram illustrating the progress of the proposed interventions of the "Balnolis" project combined with the incremental activation actions of two pilot areas (drawing: A. Cherillo and C. Prezioso).

considering the transformation project as a series of discrete operations, inserted into the context to change its meaning, far from invasive actions. The history of the city is closely linked to the theme of production and the deindustrialization of recent decades, which has led to the decommissioning or reduction in use of entire urban and peri-urban compartments. The city of production is now a project element, no longer as a void, but as "one among those resources of immediate availability capable of activating not only reorganizational-functional processes of

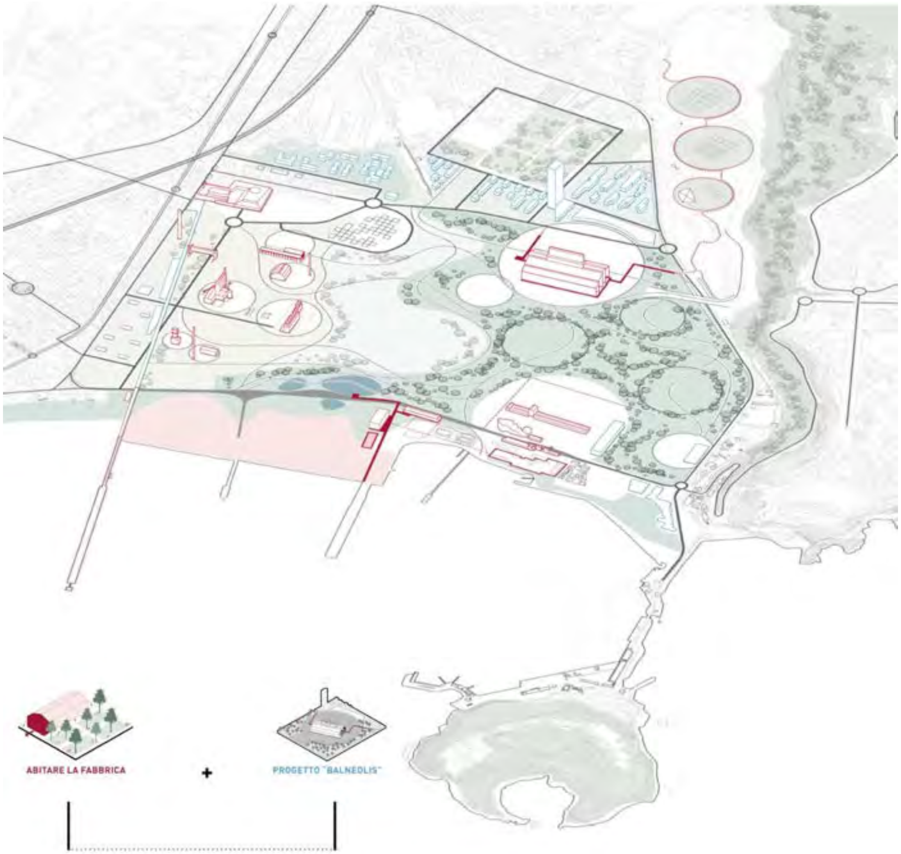
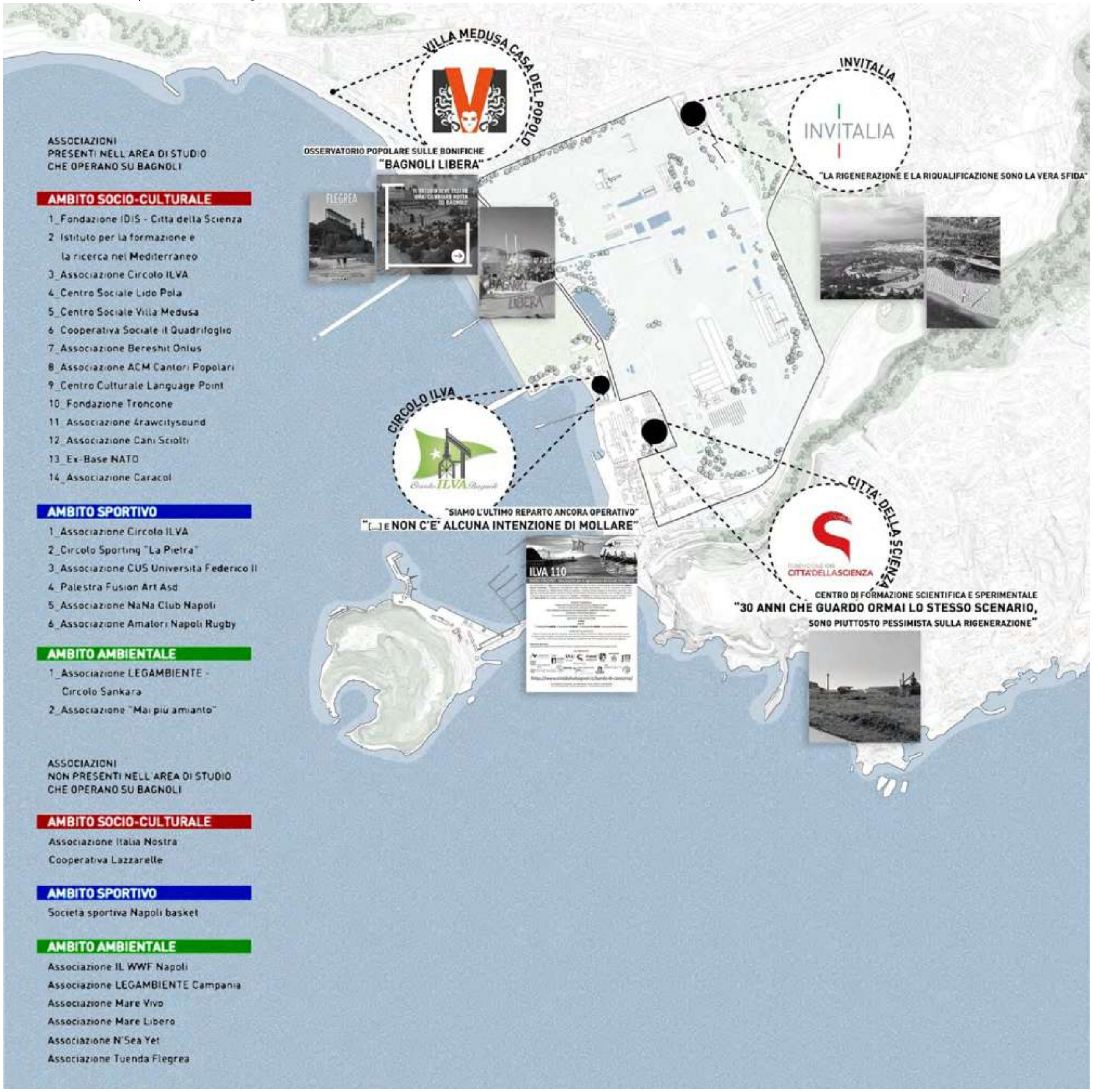


Fig. 4. Axonometric diagram illustrating the integration of the proposed intermediate actions with the final implementation of the "Balneolis" project (drawing: A. Cherillo and C. Prezioso).

the territory, but also the social and economic development of our cities" (Sposito, 2012, p. 12).

In the outlined perspective, the case of the former steel center of Bagnoli - starting from its image of abandonment – the industry offers a possibility of rebirth based on its intrinsic characteristics, on the "waiting stones" present in the place, as stated by Daniele Vitale. This interpretation transcends the mere concept of "ruins", as there is a latent vitality waiting to be brought to light (Vitale, 1996, p. 41).

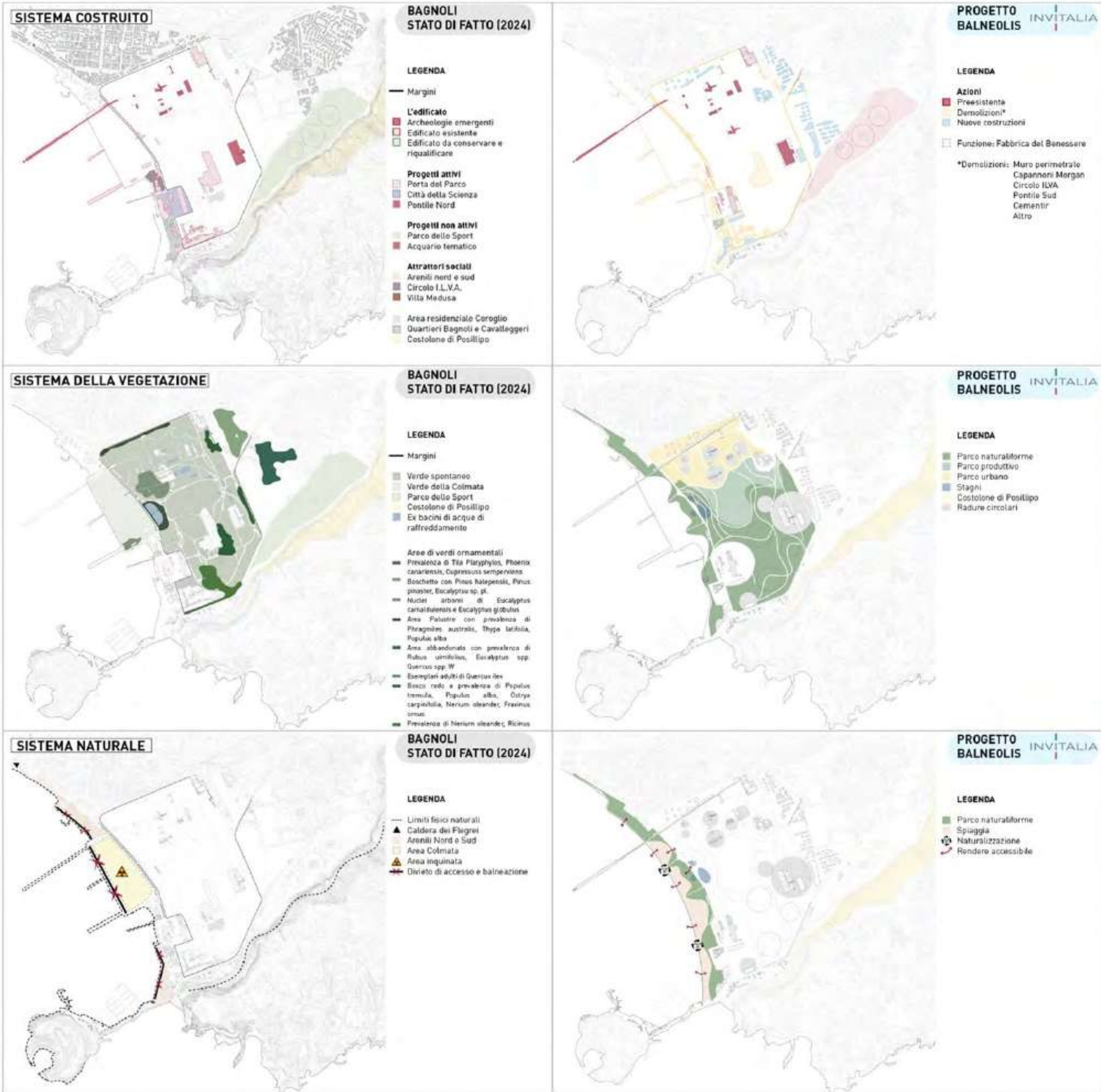

VILLA MEDUSA CASA DEL POPOLO
INVITALIA
OSSERVATORIO POPOLARE SULLE BONIFICHE
"BAGNOLI LIBERA"
"LA RIGENERAZIONE E LA RIQUALIFICAZIONE SONO LA VERA SFIDA"
CIRCOLO ILVA
"SIAMO L'ULTIMO REPARTO ANCORA OPERATIVO"
"[...] E NON C'E' ALCUNA INTENZIONE DI MOLLARE"
CITTA' DELLA SCIENZA
CENTRO DI FORMAZIONE SCIENTIFICA E SPERIMENTALE
"30 ANNI CHE GUARDO ORMAI LO STESSO SCENARIO,
SONO PIUTTOSTO PESSIMISTA SULLA RIGENERAZIONE"
ASSOCIAZIONI
PRESENTI NELL'AREA DI STUDIO
CHE OPERANO SU BAGNOLI
AMBITO SOCIO-CULTURALE
1_Fondazione IDIS - Città della Scienza
2_Istituto per la formazione e la ricerca nel Mediterraneo
3_Associazione Circolo ILVA
4_Centro Sociale Lido Pola
5_Centro Sociale Villa Medusa
6_Cooperativa Sociale il Quadrifoglio
7_Associazione Bereshit Onlus
8_Associazione ACM Cantori Popolari
9_Centro Culturale Language Point
10_Fondazione Troncone
11_Associazione 4rawcitysound
12_Associazione Cani Sciolti
13_Ex-Base NATO
14_Associazione Caracol
AMBITO SPORTIVO
1_Associazione Circolo ILVA
2_Circolo Sporting "La Pietra"
3_Associazione CUS Università Federico II
4_Palestra Fusion Art Asd
5_Associazione NaNa Club Napoli
6_Associazione Amatori Napoli Rugby
AMBITO AMBIENTALE
1_Associazione LEGAMBIENTE - Circolo Sankara
2_Associazione "Mai più amianto"
ASSOCIAZIONI
NON PRESENTI NELL'AREA DI STUDIO
CHE OPERANO SU BAGNOLI
AMBITO SOCIO-CULTURALE
Associazione Italia Nostra
Cooperativa Lazzarelle
AMBITO SPORTIVO
Società sportiva Napoli basket
AMBITO AMBIENTALE
Associazione IL WWF Napoli
Associazione LEGAMBIENTE Campania
Associazione Mare Vivo
Associazione Mare Libero
Associazione N'Sea Yet
Associazione Tuenda Flegrea

Thus, urban regeneration, associated with the reuse of abandoned industrial heritage, becomes a dynamic process that requires not only the preservation of existing values, but also the definition of innovative proposals capable of meet-ing various functional, social and cultural needs.
The research represents the most concrete testimony of the necessary and indispensable relationship between the university and the city, equal protagonists in a common development, where education becomes - as Mumford argues – "[...] the central nucleus of the new urban and cultural organization" (Mumford, 2007, p. 254). Therefore, the main objective has been the formulation of "possible visions", starting from an "academic social responsibility", which seeks synergistic and impactful solutions.
In order to encourage critical thinking, the research conducted by students has attempted to reconstruct the specific character of the place, through focused analyses conducted on thematic levels. The case of Bagnoli represents an emblematic example of how urban regeneration can be driven by the reuse of existing industrial heritage, turning it into an opportunity for the local community. The collaboration between the university and the city proves itself es-sential in this process, as it allows for the development of innovative solutions and the construction of a shared vision for the future of the area.

An incremental approach to analysis and design processes for industrial sites in disuse

From the transformation of the former industrial site as the "Nuova Italsider" and "Bagnolifutura", through "Ilva" and "Bagnoli S.p.a.", up to the "Balneolis e la nuova Stagione Felix" project [1], about 250 hectares - previously occupied by the steel plant - are now set to become an urban park. The goal is to create an ecological network linking the sea and the hillside, with a focus on enhancing the industrial heritage. However, the future of this place remains uncertain, an area suspended between "the no more and the not yet", with "the regret [...] of helplessly witnessing the continuous delays of the transformation works, while the inexo-rable

Fig. 5. The first "cognitive" phase guided the understanding of both the physical context through field visits in the extensive western suburb and the social context through dialogues with residents, local entrepreneurs and active associations in the area (drawing: A. Cherillo and C. Prezioso).


SISTEMA COSTRUITO
BAGNOLI
STATO DI FATTO (2024)
LEGENDA
Margini
L'edificato
Archeologie emergenti
Edificato esistente
Edificato da conservare e riqualificare
Progetti attivi
Porta del Parco
Città della Scienza
Pontile Nord
Progetti non attivi
Parco dello Sport
Acquario tematico
Attrattori sociali
Arenili nord e sud
Circolo I.L.V.A.
Villa Medusa
Area residenziale Coroglio
Quartieri Bagnoli e Cavalleggeri
Costolone di Posillipo
PROGETTO
BALNEOLIS
INVITALIA
LEGENDA
Azioni
Preesistente
Demolizioni*
Nuove costruzioni
Funzione: Fabbrica del Benessere
*Demolizioni: Muro perimetrale
Capannoni Morgan
Circolo ILVA
Pontile Sud
Cementir
Altro
SISTEMA DELLA VEGETAZIONE
BAGNOLI
STATO DI FATTO (2024)
LEGENDA
Margini
Verde spontaneo
Verde della Colmata
Parco dello Sport
Costolone di Posillipo
Ex bacini di acque di raffreddamento
Aree di verdi ornamentali
Prevalenza di Tila Platyphylos, Phoenix canariensis, Cupressuss sempervirens
Boschetto con Pinus halepensis, Pinus pinaster, Eucalyptus sp. pl.
Esemplari adulti di Quercus ilex
PROGETTO
BALNEOLIS
INVITALIA
LEGENDA
Parco naturaliforme
Parco produttivo
Parco urbano
Stagni
Costolone di Posillipo
Radure circolari
SISTEMA NATURALE
BAGNOLI
STATO DI FATTO (2024)
LEGENDA
Limiti fisici naturali
Caldera dei Flegrei
Arenili Nord e Sud
Area Colmata
Area inquinata
Divieto di accesso e balneazione
PROGETTO
BALNEOLIS
INVITALIA
LEGENDA
Parco naturaliforme
Spiaggia
Naturalizzazione
Rendere accessibile

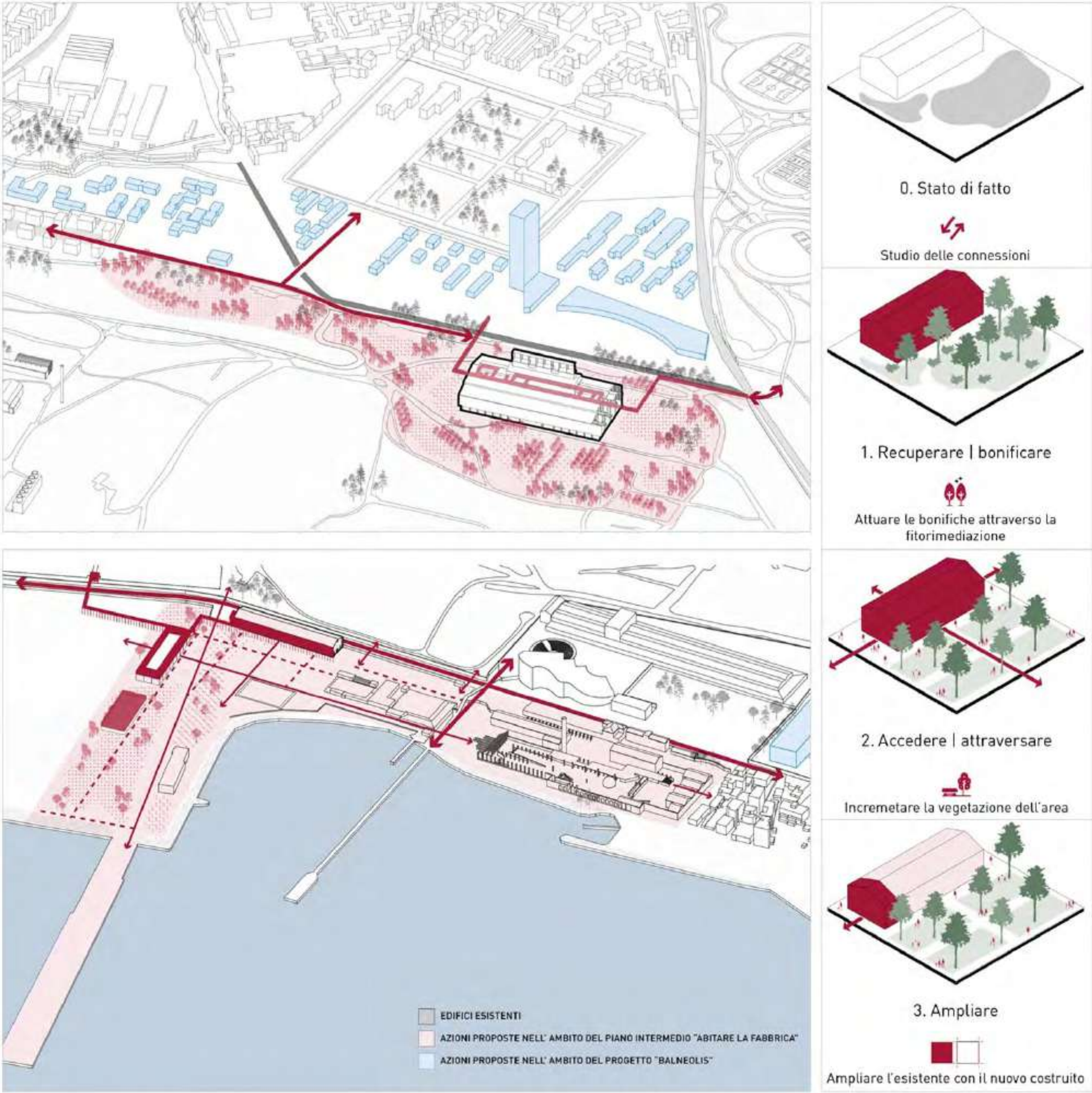
passage of time is now fading the memory of the factory" (Capasso, 2020, p. 131). To address this challenge, a new approach was undertaken in the thesis studio that aims at an alternative reading of the context and a site-oriented design. Rather than focusing on the inefficiency of the plans already proposed for these areas, an attempt was made to identify a model of project development as a form of "mediation", with the aim of initiating actions that can restore new ways of living for previously abandoned spaces.

The thesis research is characterized by its interdisciplinary approach, serving as a fundamental workspace for sharing reflections and perspectives from different disciplines. This context allows for the integration of a wide range of knowledge and skills, crucial for structuring a comprehensive and well-articulated project workflow. The aim is to create synergy among contributions from different fields, with the goal of formulating innovative and effective solu-tions. This gradual approach allows for the progressive tackling of challenges, adapting and optimizing intervention strategies based on the results obtained and the new knowledge acquired along the research journey. Moreover, the research's diverse phases have spurred reflections that have guided the architectural project. This includes exploring modes of collaboration with stakeholders representing varied interests, such as residents, third-sector organizations, academic institutions, entrepreneurs, and traders. Additionally, it entails examining the structure and nature of the ur-ban project, from urban and architectural strategies to landscape design, while considering the actions required to manage, maintain, and support regenerated spaces.

In this regard, the thesis studio has endeavored to provide a concrete response to the regeneration of the former in-dustrial area of Bagnoli, starting from the environmental remediation and urban regeneration program (P.R.A.R.U.) [2], promoted by Invitalia, and the subsequent international competition "UrbaNAture" [3], which became structuring elements for defining the research question.

The thesis has been structured in three phases where the understanding

Fig. 6. Comparison maps making explicit the current condition of Bagnoli and the directions of the winning project, produced during the discussion phase with Invitalia, the entity responsible for the revitalization program of the industrial area (drawing: A. Cherillo and C. Prezioso).


EDIFICI ESISTENTI
AZIONI PROPOSTE NELL' AMBITO DEL PIANO INTERMEDIO "ABITARE LA FABBRICA"
AZIONI PROPOSTE NELL' AMBITO DEL PROGETTO "BALNEOLIS"
0. Stato di fatto
Studio delle connessioni
1. Recuperare | bonificare
Attuare le bonifiche attraverso la fitorimediazione
2. Accedere | attraversare
Incremetare la vegetazione dell'area
3. Ampliare
Ampliare l'esistente con il nuovo costruito

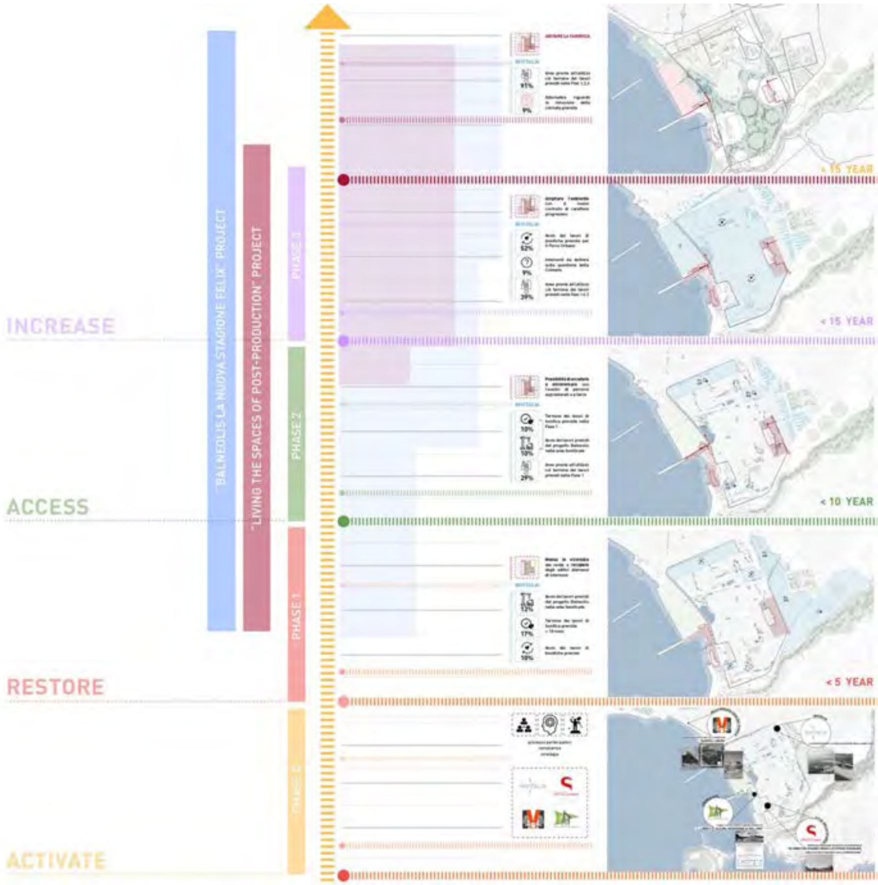


Fig. 8. Diagram of the intermediate temporal plan named "Living the spaces of post-production", structured in a progressive sequence of project actions - activating, regenerating, accessing, expanding - by combining the strategies of the winning project "Balneolis" (drawing: A. Cherillo and C. Prezioso).

of the territory was deepened to compre-hend the physical and socio-cultural conditions of the area; dialogue and engagement with various stakeholders were initiated, and finally, an operational intervention strategy was proposed. The first "cognitive" phase guided the under-standing of both the physical context through field visits in the extensive western periphery and the social fabric through dialogues with residents, local entrepreneurs, and active associations in the area [4].
In particular, interactions with the Circolo Ilva, which has long promoted

Fig. 7. The diagrams illustrate the two pilot areas to be activated to trigger the wider regeneration process and the proposed strategic program for incremental actions (drawing: A. Cherillo and C. Prezioso).

social inclusion and promotion actions, were of great source of knowledge (Fig. 5). The subsequent "engagement phase" was characterized by an active dialogue with Invitalia, the entity responsible for the remediation and revitalization program of the former industrial area of Bagnoli. This engagement was useful for understanding the status of the remediation efforts and the implementation of the winning project "Balneolis", identi-fying strategic directions and implementable criticalities (Fig. 6).
In the third phase, after identifying two potential areas of "urban reactivation" - the steelworks factory and the Circolo Ilva warehouses - an intervention strategy was developed, focused not on a defined project, but rather on a program defining the type of transformations, uses, and activities needed to support future regeneration (Fig. 7).
The research outcome is the intermediate temporal plan named "Living the spaces of post-production", structured in a progressive sequence of project actions - activating, regenerating, accessing, expanding - suggesting which actors to involve, which remediation interventions to implement, and what types of architectural and urban interventions can facilitate this transformation process. The aim is to combine the strategies of the winning project "Balneolis" with in-crementally implemented actions, allowing the community to "live" in spaces previously neglected or abandoned while the large urban park is being realized (Fig. 8).
After the initial activation, supported by participatory communication and engagement processes to involve interested actors, interventions are carried out to ensure the safety and recovery of disused buildings, simultaneously with the start of remediation works. At the end of the activation and regeneration phases, access will be possible through elevated and ground paths in areas ready for use. This operational sequence provides a basis for expansion actions through interventions on existing structures, thus offering the possibility of "Living the spaces of post-production".
The proposal aims to cooperate with the "Balneolis" project. In the new context, the Circolo Ilva contrary to the planned relocation of its spaces, will retain a central position, acting as a hinge between the waterfront

Fig. 9. The vast former Ilva area of Bagnoli from the hill of Posillipo (photographs: A. Cherillo and C. Prezioso).

and the large park, in continuity and installing an uninterrupted dialogue between the two landscapes. Consequently, actions are proposed to facilitate communication between the park and the sea, protecting and enhancing the spaces of the Circolo Ilva as a "space of social inclusion and knowledge", through the realization of the "Ilva Archive Museum of Bagnoli" and the enhancement of sports and social activities through the activation of agreements with territorial partners.

The proposed project for the former steel factory area represents an innovative approach aimed at reclaiming and en-hancing this important historical and industrial site. The approach is structured through a series of incremental phas-es, with the goal of transforming the area into an accessible and functional space for the community. Central to the project is the development of a modular construction system that can accommodate various urban functions. Using modular and flexible structures such as walkways, arcades, stairs, and alcoves, the project aims to adapt to the chang-ing needs of the community and offer opportunities for use.

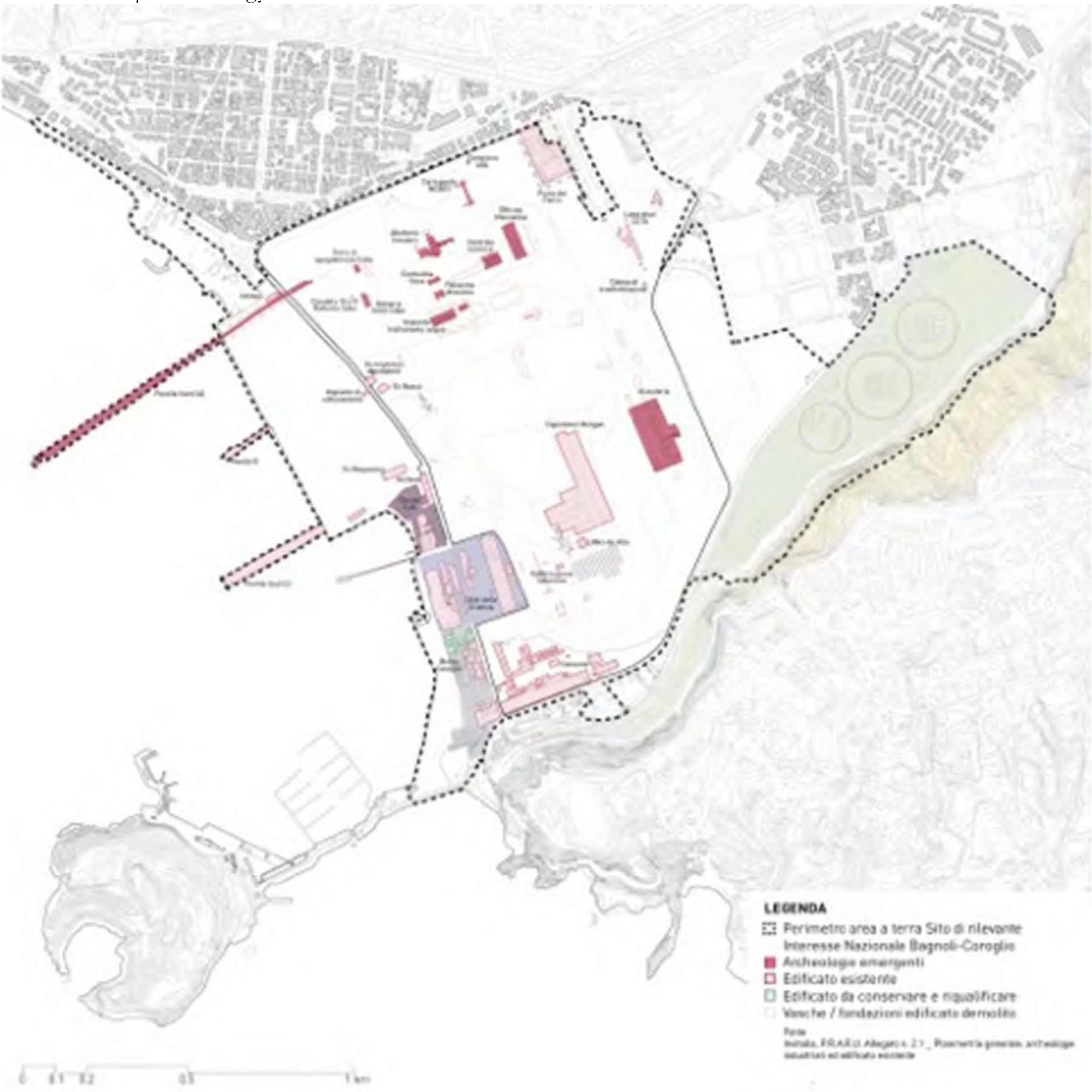
One of the initial phases of the project involves creating an elevated

pathway to allow access to the interior of the former plant. This enables visitors to explore the area safely and admire the industrial monuments that characterize the urban landscape. Subsequently, the module is expanded to envision semi-public spaces that can be equipped for various urban activities and functions. The vertical configuration of the structures allows users to have a full awareness of the natural terrain, traversing different layers of uses and landscape, thus creating a harmonious blend between the industrial history of the site and the contemporary needs of the community.
To sum up, the thesis research has provided a valuable opportunity to reconsider intervention approaches in particularly fragile areas, offering a process that acknowledges the adaptability of transformations to the specific characteris-tics and timelines of the places. At the core of this process emerged the need to define programs that not only guide the execution of the transformations, but also support their management and long-term development. This incremen-tal project development model not only raises crucial questions but also opens up to a wide range of possible future scenarios. It invites further research to explore the various forms that architecture can take into consideration by ad-dressing the dynamics of transformation in contemporary cities.
A deep understanding of these dynamics and their integration into design processes is essential to develop effective and sustainable solutions that meet the needs and challenges of modern urban communities.

The Industrial Heritage

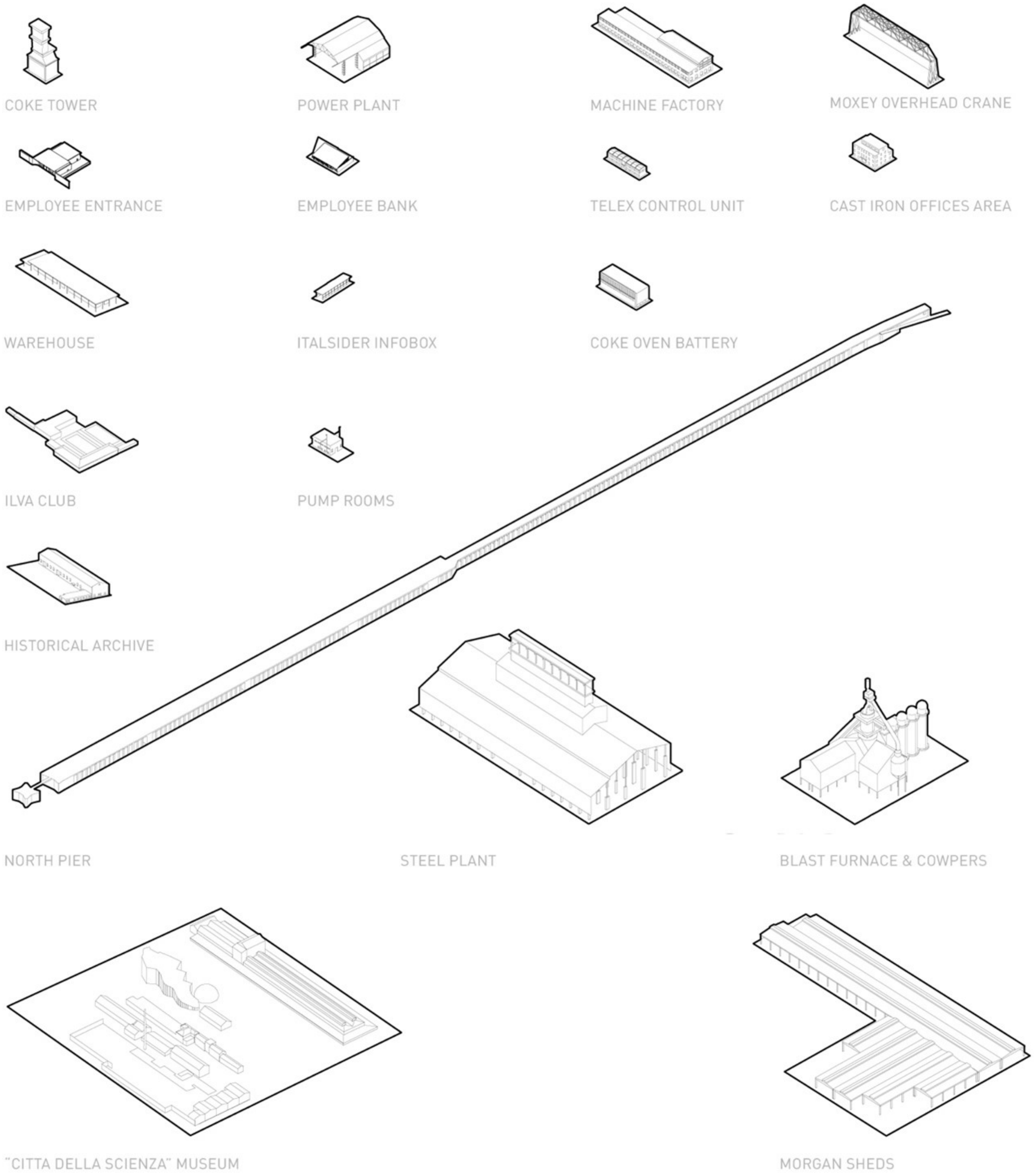
Whoever looks today from the hill of Posillipo at the vast former Ilva area of Bagnoli cannot but notice the "remains" of the plant that has been disused for almost thirty years, alternating with vast uncultivated green areas (Fig. 9).
A sort of large archaeological park (belonging to a recent past) closed to the city by a wall, which the gaze cannot grasp except in relation to a landscape context. Within the large enclosure, the smokestacks, blast furnace and espe-cially the steel mill, an imposing monument of modern

Fig. 10. Some "remains" of industrial archaeology within the large enclosure (photographs: A. Cherillo and C. Prezioso).


LEGENDA
Perimetro area a terra Sito di rilevante Interesse Nazionale Bagnoli-Coroglio
Archeologie emergenti
Edificato esistente
Edificato da conservare e riqualificare
Vasche / fondazioni edificato demolito
Fonte

times, seemingly casually located. But no building has random type, shape, and location in a manufacturing plant (Fig. 10).
Not far from Ilva, set in the same scenery of the Phlegrean fields stands out the Olivetti factory in Pozzuoli, where Luigi Cosenza, interpreted in a completely innovative key the idea of the factory and its relationship with the envi-ronmental context inspired by the idea that the project takes on the rules of the place and then confers new ones. Reproposing such an exercise for the SIN area of Bagnoli, becomes a necessary, albeit somewhat complex, action. It means addressing the issue of regeneration from two questions: what are the "rules" to be incorporated? What are the "rules" to be assumed in the project?
In this specific case, bringing these aspects back to the way of approaching the topic of industrial archaeology, it is a must to remember that such "remains" were part of a system created with the precise purpose of making the factory work. No construction, from the blast furnace to the wharf, from the steel mill to the machine shop, is conceived independently of the other: each artifact played its own role in perfect relation to the others and in function with the development needs of the production process.
These are not stand-alone constructions but a system of architecture and infrastructure, placed according to a logic never divorced from the context, based on the phases and sequences of the industrial cycle. All starting with the im-posing presence of the North wharf that connects the complex with the sea, the starting point of the cycle, the place of arrival of raw materials then deposited next to it in the storage area, originally located within the enclosure between the boundary of Via Coroglio and Via Diocleziano, and later moved to the fill along the coast. With the decommissioning, dismantled the road and track infrastructure, the built-up area of the industrial era emerged, "remnants" not without value, coinciding with what the Nizhny Tagil charter defines as industrial heritage: "industrial heritage represents history, architecture and technology in different time and area, which needs to keep in good condition for next generations" (TiCCiH, 2003).

Fig. 11. General plan: industrial archaeology and existing buildings. Source: Invitalia, Program for environmental renovation and urban regeneration. Bagnoli - Coroglio site of relevant national interest. Update: March 2018 (drawing: A. Cherillo and C. Prezioso).


COKE TOWER
POWER PLANT
MACHINE FACTORY
MOXEY OVERHEAD CRANE
EMPLOYEE ENTRANCE
EMPLOYEE BANK
TELEX CONTROL UNIT
CAST IRON OFFICES AREA
WAREHOUSE
ITALSIDER INFOBOX
COKE OVEN BATTERY
ILVA CLUB
PUMP ROOMS
HISTORICAL ARCHIVE
NORTH PIER
STEEL PLANT
BLAST FURNACE & COWPERS
"CITTA DELLA SCIENZA" MUSEUM
MORGAN SHEDS

A heritage, this one, recognized as early as March 1999, when sixteen industrial artifacts were selected for relevance and state of preservation among those not yet demolished at the time, and in 2005 incorporated into the PUA with the aim of "restoring the extraordinary environmental conditions that were erased by the construction of the factory and, at the same time, preserving in non-superficial forms the memory of the recent productive past, especially for the significance it had in the formation of a labor culture in our city" (Figg. 11, 12).
The pre-existence must be thoroughly investigated in order to carp about its real possibilities for adaptation to strate-gies and plans of reconversion. Only if "vivisected and loaded with enough symbolism to bring out its characteristics as a shared good, and therefore susceptible to protection" (Zorgno, 1998) will the factory be able to show itself as a resource for the contemporary project.
While recognizing the value of the industrial site, today we have the right-duty to recover the environmental value of that area as well, restoring a balanced relationship between natural and industrial heritage. Hence the need to use an environmentally sustainable approach to the project. In this perspective, the building as such was not taken into consideration, rather the work aimed to focus on that " 'mechanics' of existential space which takes the form of the building of a harmonious fabric, encompassing both the natural and the artificial and responding to changing housing needs...in search of a new rootedness of things and man and nature, it being well understood, however, that the characteristic of the human species is the ability to modify na-ture, to make it more and more suitable for its own survival" (Vittoria, 1960).
In this perspective, the project starts from some paradigms of contemporary building dictated on the one hand by the need to rebuild a network of relationships between the built, itself understood as a resource and natural resources, in order to: principles of bioclimatic environmental design (partly already present in the types of industrial pavilions equipped with skylights designed to rationalize light and ventilation to the working environments); systems of energy production from renewable sources,

Fig. 12. Classification of industrial archaeologies. Source P.R.A.R.U. Annex no. 2.2. Urban Regeneration. Title: Industrial archaeology with description of the state of degradation. Update: March 2018 (drawing: A. Cherillo and C. Prezioso).

Fig. 13. The disused industrial area of Bagnoli as a valuable resource of naturalness and urban biodiversity (photograph: A. Cherillo and C. Prezioso).

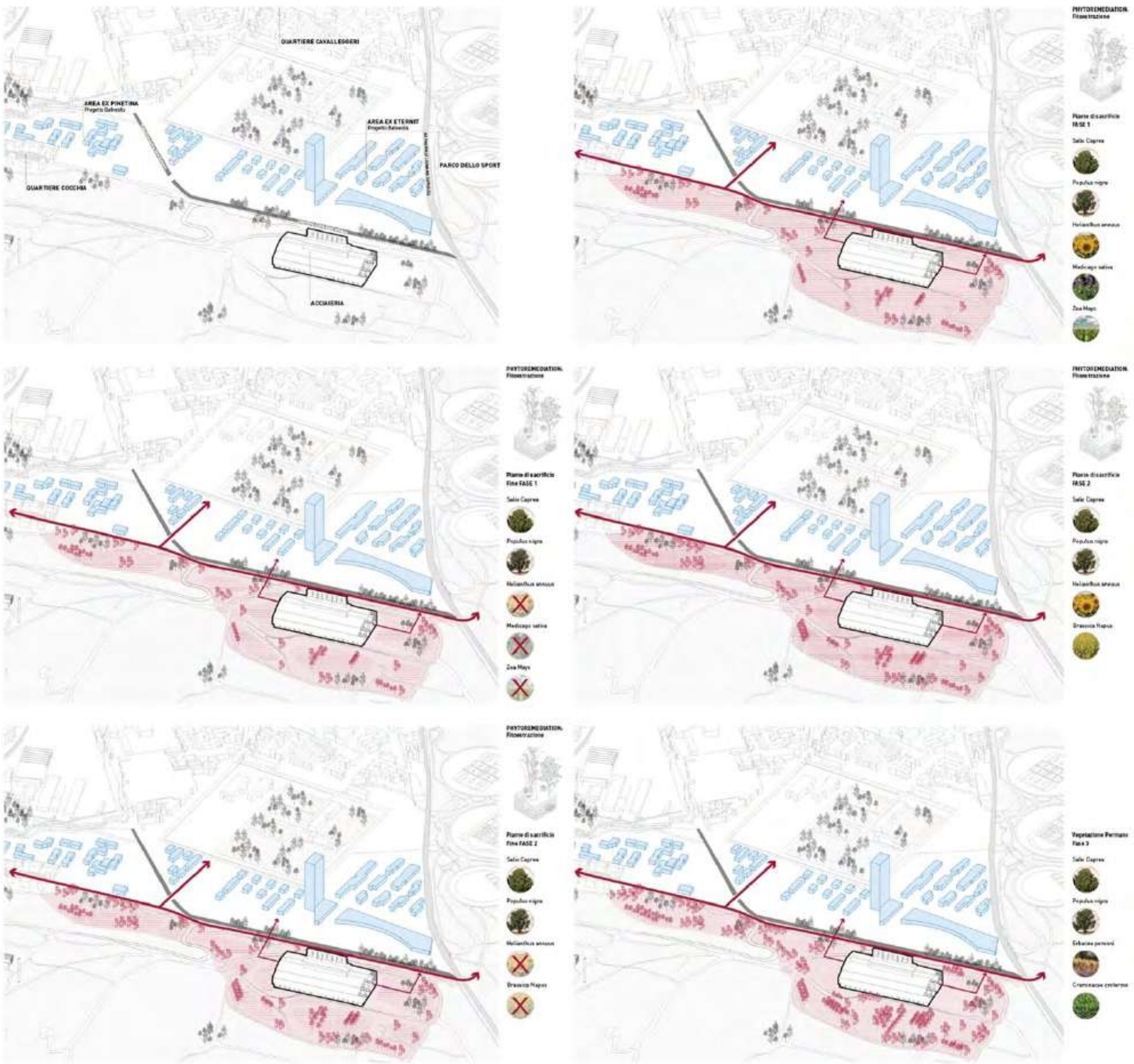
in compliance with and beyond the thresholds provided by current regulations and protocols; as well as the principles of an architecture in the making, based on the uncertainty of construction and operating times, thus also providing for temporary, semi-permanent or permanent constructions, to provide for a progressive use of pre-existing volumes.
Regarding the latter aspect, the time factor was decisive in the choice of construction principles appropriate to what are the needs of the contemporary project, versatile for a variable and evolving demand, in

accordance with the stra-tegic objective defined by the Intermediate Time Plan within which the project proposal is placed. Hence the logic of operating from the perspective of landscapes "in transition", transforming pre-existing architectures into architectures "in the making" through the grafting of innovations, recovering peculiarities and implementing performance in terms of the environment and usability of spaces.

Within the timeframe required for remediation, in anticipation of time-varying uses, potential levels of transformabil-ity of the artifact need to be established, and the where and how of adding new volumes, components, technologies for water reclamation and energy production from renewable sources needs to be identified, with a view to "adaptive reuse" (Robiglio, 2017).

The choice obviously fell on systems and materials that meet the paradigms of reversibility, recyclability and the main environmental criteria aimed at making a project meet the goals of the Green Deal.

The proposal has focused on two among the existing volumes, different in type, structure, materials, location, but which in common have a high strategic value insisting on two edge areas close to two of the main axes that delimit the intervention area: the steel mill next to via Leonardi Cattolica, for which a semi-permanent construction is planned, and the shed of the former archive, destined to assume a permanent function whose side front insists on the sidewalk of via Coroglio, southwest towards the coast. The design hypotheses basically start from two assumptions. In the first case, that of the steel mill, interventions were considered that would allow the activation of functions even during the planned soil remediation activity using natural processes. Based on the logic of building in the built environment, a lightweight system with a structural steel cage and performance closure panels was assumed. The framed structure, an autonomous grid from the existing, allows the interior of the shed to be gained by accessing an intermediate elevation from the outside via a walkway to avoid contact with the soil at least until ecological regeneration processes restore the natural balance of the outdoor and covered areas.


QUARTIERE CAVALLEGGERI
AREA EX PINETINA
AREA EX ETERNIT
PARCO DELLO SPORT
QUARTIERE COCCHIA
ACCIAIERIA

In the second case, relating to the former Historical Archive destined also by its construction characteristics to last over time, special attention was given to technological and functional retrofit solutions, attentive to in-door wellbeing and energy saving. The retrofit actions therefore involved the entire shed, the external envelope and the construction of a new body leaning against the pre-existing one that allowed through the volume exposed to S-W to control and optimize environmental resources, filtering lighting and irradiation with a variable configuration façade system. In addition, on the large outdoor space, the semi-open volume intended as exhibition space, alternates ideal light and shade zones in a context facing the sea, characterized by the landscape design of sea dunes, mediates the indoor-outdoor relationship. The creation of shaded areas and the attention to the materials and color of the outdoor flooring, lowers the risk of generating heat islands, keeping the effects of the climate characterized in summer by the sea breeze con-stant.
When the Italsider (ex Ilva) in Bagnoli was decommissioned and the first demolitions began in Germany the RHUR had already become the Emscher Landschaftpark area, a reference of environmental regeneration and landscape de-sign. Today we are aware of how much damage has been done by abandoning the Ilva artifacts, turned into ruins, whose demolition would produce waste to the detriment not only of the identity of the building but of the habitat in which we live. The motivation that drives us to conserve the existing comes from this dual need, cultural and envi-ronmental, but we must not forget that the main purpose of the project is to return to those architectures born for other purposes, and in the past place of polluting productions, the role of mediation between natural resources and human needs for indoor and outdoor comfort, respecting the planet as a "common home".

The Landscape Project

"Coping with post-industrial sites is a pressing issue throughout Europe and North America. One point of departure for their general rediscovery was the revitalisation by Latz + Partner in the early 1990s of an abandoned

Fig. 14. Planned phytoremediation process in the Acciaieria area, featuring sacrificial and permanent vegetation for environmental reclamation (drawing: A. Cherillo and C. Prezioso).

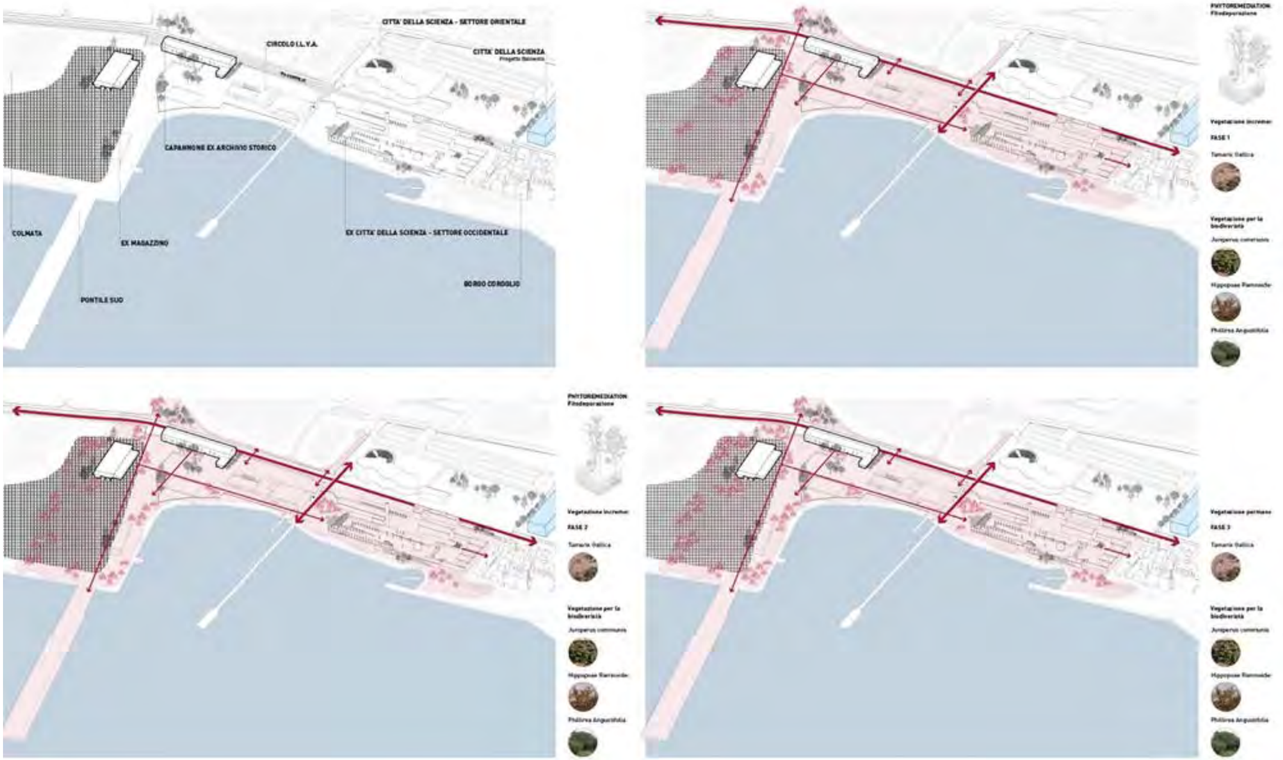


Fig. 15. Proposed Mediterranean dune landscape design for the Circolo Ilva area. Tamarisk trees (Tamaris gallica) and a variety of dune grasses and shrubs are strategically planted to enhance biodiversity and remediate polluted soils, while providing a picturesque backdrop for sports and recreational activities (drawing: A. Cherillo and C. Prezioso).

steelworks as Landschaftspark Duisburg-Nord; industrial relics were not demolished but seen as integral parts of the overall concept and imbued with new meanings and uses. Many more projects with a similar approach have since been executed, the most seminal such as Chemetoff's Île de Nantes, Parc del Clot in Barcelona, Hargreaves/PROAP's Parque do Tejo e Trancao in Lisbon and Michel Desvigne's Parc aux Angéliques in Bordeaux" (Braae, 2015).

The onset of the new millennium has raised the major issue of disused industrial areas reconversion These are those territories, the outcome of a post-industrial condition now widespread and consolidated, that underwent radical changes brought about by the rapid industrialization

processes of the nineteenth century, reaching their productive peak in the twentieth century, only to gradually cease their activities, leaving behind a huge number of abandoned areas with disused infrastructure and barren soils. Brownfields are part of that wide range of "latent landscapes" (Gioffrè, 2018) waiting to be discovered, interpreted, and restarted to a new life cycle, landscapes that constitute an untapped wealth of ecological and social resources for the contemporary city.
At the turn of the year 2000, coinciding with the evolution of the concept of landscape and the huge issue of brownfield redevelopment, novel approaches to landscape design with significant new works were born and spread internationally.
In Germany, where an ecological and environmentalist tradition is well established, there are some of the most significant experiences of a design culture that can be considered avant-garde in contemporary times. The histories and qualities of abandoned sites are reimagined in the transformed landscape to reveal the dramatic changes that have been made to these places in a short period of time. As part of the more general process of reclaiming the Rhur Valley, where one of the largest brownfield sites in Europe stood, Peter Latz created the famous Duisburg Park. The German landscape architect does not operate an erasure of the industrial pre-existences; on the contrary, he ennobles them by elevating them to the rank of real "ruins" of a recent modernity and defining overall a "sublime" post-industrial landscape (Latz, 2016).
Pylons, cisterns, and metal platforms dialogue with the vegetation inserted into the design that envelops and integrates them into a single context. The result is an overall design of the park that expresses an unprecedented aesthetic quality, a re-actualization in a contemporary key of the nineteenth-century style of the picturesque. Latz is also among the designers of the Dora Park in Turin, also built in a disused industrial area, where once again the design choice is to maintain some of the pre-existing structures that acquire, in the total resignification of the site, a new iconic value. The path opened by Latz, as supported by Braae in the quotation given at the opening of this text, has led today to the realization

of some particularly significant works. Latz's proposed approach, focused on rewriting brownfields while minimizing the demolition or erasure of pre-existing structures, has also been the central reference of this design research work for Bagnoli. The research project for the Ex-Italsider area, proposed here, defines an evolving landscape that is not structured on assertive and definitive configurations but, rather, on changing and transitional scenarios capable of accommodating further grafts and additions over time. The disused industrial area of Bagnoli, in fact, can be considered an emblematic example of a "third landscape" (Clément, 2014): it is already a valuable resource of naturalness and urban biodiversity not only for Bagnoli, but for the entire city of Naples, thanks to the ongoing process of spontaneous renaturalization.

The project in the Ex-Italsider of Bagnoli can only arise from the assignment of new qualities and new value to an area, emblematic of the complex and contradictory post-industrial condition of contemporaneity, accepting its distortions and contradictions, in order to define a new adaptive, ecological, shared and open landscape for the community of Bagnoli and Naples (Fig. 13). In fact, the time frame for the realization of "Balneolis and the New Felix Season", the first-place project in the in-ternational design competition promoted by Invitalia in 2021, will inevitably be very long.

The project drawn up by RTI Constituent S.B. Arch-Studio Bargone Architetti Associati proposes a monumental interven-tion with the cancellation of the current spontaneous nature forms and the total rewriting of the site. The project proposes, with an excess of formalism, the figurative reference to the circles of volcanic calderas and to the famous definition of campana felix given by the Romans for the fertile Campania countryside. It is therefore necessary to propose "landscapes in transition" that can gradually make parts of the disused industrial area of Bagnoli usable.

The landscape design proposed here is centered on two principles: the first is to carry out soil remediation through natural processes, thus using phyto-remediation and bio-remediation techniques whose effectiveness is widely demonstrated in similar cases; the second design principle involves the gradual and progressive opening of areas al-ready compatible with public use. Thus, the vegetation envisaged in the landscape design performs a dual function: that of an "ecological machine" for soil reclamation; and the aesthetic and perceptual function of a qualifying element of the entire area to define new spatial configurations that evolve with natural processes. In this design scenario, nature, with its ecological times and processes, returns to be the protagonist of the Bagnoli landscape.

In this hypothesis, the landscape project is generated by the landscape and not vice versa; the project is not a prepackaged abstract geometry that lands on the site colonizing it, but rather a sensitive reinterpretation of the existing that generates new forms and spaces.

The project proposes two thematic insights in two areas: the "Acciaieria", and the "Circolo Ilva". For Acciaieria area (Fig. 14), massive use of sacrificial vegetation, especially herbaceous and shrubby vegetation, is planned in the first phase to start the phytoremediation process. In a phase, when the remediation process is already underway, the progressive planting of permanent vegetation consisting of trees (Salix caprea and Populus nigra) and her-baceous perennials. After reclamation is completed, the Acciaieria landscape will be characterized by geometric poplar forests, widespread systems of willows, and dense meadows of perennials.

For the area surrounding the Circolo Ilva (Fig. 15), being near the sea, the intervention consists of building a Mediterra-nean dune landscape. The project includes the planting of tamarisk (Tamerix gallica), a tree typical of sandy coasts also in the Campania Region, which in addition to its aesthetic value also does an excellent job of cleaning up polluted soils. In addition, a collection of dune grasses and shrubs will be planted to increase biodiversity. The result is thus the defining of a Mediterranean landscape that can well accommodate the sports and recreational activities of the Circolo Ilva. The interventions proposed for both cases, the arboreal landscape of the Acciaieria and the dune landscape of the

Circolo Ilva, will also and above all make it possible to significantly increase the biodiversity of the site by attracting new plant and animal species.
The most avant-garde Landscape Architecture is today understood as a "therapeutic tool" (Jacob, 2009) capable of repairing the damage caused by the industrial development of the last two centuries; it is a specific approach that pro-vides responses to contemporary global crises, from environmental to social and health ones, with a design attitude that repositions Man's relationship with the Nature of which he is part, according to principles of co-evolution: "Following the relational models also in the field of meaning of the landscape, it is possible to trace a path that brings us closer to the themes of co-evolution in the contemporary world (...) new interpretative references are involved in the change in meaning of three main terms constitutive of modern thought: nature, earth, evolution (Caravaggi, 2022).

Notes

[1] The project "Balneolis e la nuova Stagione Felix" was awarded First Prize at the Bagnoli UrbaNAture Competition (2021). It proposes the transformation of the site, a former industrial area characterized by decades of abuse and pollution, through a metamorphosis that returns to the ideal of "Campania FELIX". This contemporary interpretation of the genius loci aims to highlight the natural, agricultural, chromatic, aesthetic, and well-being characteristics specific to this part of Campania, which the Romans considered both fertile and "felice". The abbreviation "Balneolis" is used to refer to the project title within the text.

[2] See: https://www.invitalia.it/cosa-facciamo/rilanciamo-le-aree-di-crisi-industriale/rilancio-bagnoli/doc01---programmazione-e-pianificazione.

3] A project to transform the 250 hectares of Naples' former industrial area into one of the largest urban parks on an international scale.
See https://bagnolicontest.invitalia.it/i-progetti.

[4] The involved associations - Villa Medusa, Lido Pola, Circolo ILVA Bagnoli, Fondazione Idis Città della Scienza - actively participated in the meetings, sharing the experiences and needs of the local community.

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References

Braae, E. (2015). *Beauty Redeemed: Recycling Post-Industrial Landscapes*. Basilea: Birkhauser Architecture.

Capasso, G., & Pesce, G. (2020). *Bagnoli. L'ultimo casco giallo*. Casoria: Martin Eden, p. 131.

Caravaggi, L. (2022). Co-evolution. In *Ri-vista*, No. 20, pp. 5-25. <https://oaj.fupress.net/index.php/ri-vista/article/view/14310 (accesed 30 april 2024).

Clément, G. (2014). *Manifeste du tiers paysage*. Paris: Sens&Tonka.

Gioffrè, V. (2018). *Latent Landscape*. Siracusa: Letteraventidue.

Jacob, M. (2009). *Il paesaggio*. Bologna: Il Mulino Edizioni.

Latz, P. (2016). *Rust Red. Landscape Park Duisburg-Nord*. Monaco: Hirmer Publishers.

Mumford, L., et al. (2007). L*a cultura delle città*. Torino: Einaudi, p. 254.

Rea, E. (2002). *La dismissione*. Milano: Rizzoli, p. 184.

Robiglio, M. (2017). *RE-USA: 20 American stories of adaptive reuse, A toolkit for post-industrial cities*, Jovis Verlag GmbH.

Sposito, C. (2012). *Sul recupero delle aree industriali dismesse. Tecnologie materiali impianti ecosostenibili e innovativi*. Santarcangelo di Romagna: Maggioli Editore, p. 12.

The Nizhny Tagil Charter for the industrial Heritage, The international Committee for the Conservation of the industrial Heritage, TiCCiH, 2003.

Vitale, D. (1996). Le pietre d'attesa. In *Bollettino del Dipartimento di Progettazione Urbana Argomenti 2. La trasformazione delle aree dismesse nella esperienza europea*. Conference proceedings. Napoli, October 1996, p. 41.

Vittoria, E. (1960). Insegnare il design. In G. Guazzo (Ed.) (1995). *Eduardo Vittoria. Tutte le architetture*, pp. 143-144. Roma: Gangemi.

Zorgno, A. (1998). Editoriale. In *Docomomo italia giornale*, No 4, p. 1.

CHAPTER 2
European approaches
Mara Capone

One of the main objectives of the BIP program is to analyze different cultural and management approaches to disused industrial heritage. This is achieved through the presentation and analysis of emblematic case studies identified in Europe.
The contributions collected in this chapter provide valuable insights into the various methodologies and strategies employed and significantly help in structuring a comprehensive framework that addresses the various problems and perspectives associated with the protection and reuse of archaeological industrial heritage. This framework aims to define a coherent European approach by examining the similarities and differences across different countries. Distinct trends emerge from these case studies. Some interventions focus primarily on conservation, preserving the original structures and features to maintain their historical and cultural significance. Other approaches involve using parts of the industrial sites for iconic purposes, creating landmark attractions that draw attention and promote cultural tourism.
Finally, some cases involve the complete transformation and refunctionalization of the industrial heritage, repurposing the sites for new uses while integrating modern functionalities, and sometimes replacing them with new buildings, which can lead to the loss of historical memory. Through this comprehensive analysis and the sharing of best practices, the BIP program seeks to foster a collaborative and informed approach to industrial heritage conservation and reuse, promoting the sustainable development of these historically significant sites across Europe.

On side. Ex Corradini, industrial heritage. Photo by Maria Ferrara, taken during the Living Lab Inhabiting the City in Transition. Evolutionary Projects for the Reuse of Large Urban Containers (curated by Orfina Fatigato and Gianluigi Freda) included in the program of the Festival of Architecture, CA23 Campania Region Architecture in April 2023.

Parameters of transformation of industrial Heritage. Some European Case Studies

Lucas Fernández-Trapa

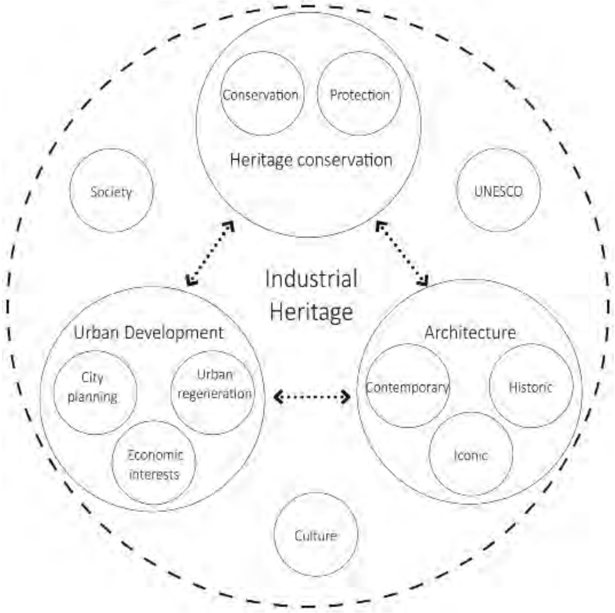
A changing world?

Industrial states grew formidably across Europe in the XIX. and beginnings of the XX. century; the textile revolution that started in England with the invention of the Spinning Jenny and the Water Frame ignited the mass production of thread and cloth. Figure 1 illustrates children working in a textile Mill in South Carolina, US, the so-called doffers (a doffer is someone who removes, or "doffs", bobbins or spindles that hold spun cotton or wool from a spinning frame, then replaces them with empty ones). This was a common sight for the last 200 years; although child work is officially banned in Europe since 1948 [1] it has been outsourced to developing countries, where children still produce a considerable amount of goods that are in turn sold in Europe [2].

The social structures typical of he XIX century have since changed substantially; Europe underwent a profound transformation from an agriculture-based society into an industrial and service oriented one. As an example, agriculture made 70% of employment in Finland in 1920, compared to a mere 4.2% in 2004 [3] a pattern that can be found across Europe. By the end of the XX. century many of the industrial states in Europe were abandoned as a result of deindustrialization and relocation of the means of production, although manufacturing output kept growing, manufacturing employment fell considerably, industrial facilities were dismantled, and the sites abandoned. The down of the XXI century has brought a shift in occupancy fuelled by the so called

Fig. 1. Young doffers in Mollahan Mills in Newberry, South Carolina, on December 3, 1908 (photo: Lewis W. Hine, re-framed).

Fig. 2. Stakeholders in the development process of Industrial Heritage. After Clash of discourses, Mieg & Overmann 2015 (drawing: author).



fourth industrial revolution (Schwab, 2017); in Europe and the US employment in manufacturing keeps falling and new jobs can be found mainly in sectors related with data management and protection, software development and health care [4].

This change of the productive tissue of our society must be taken into account when dealing with the remains of our industrial heritage, for every reformatory process has to aim at a certain goal.

When dealing with the transformation of industrial sites, there are several factors and stakeholders that influence the development and the outcome, from local authorities and landlords to cultural associations and universities and heritage related initiatives. The interests of each group collide with each other (Mieg & Overmann, 2015) and there is no universal recipe one-size-fits-all.

Although every intervention should be considered ideally within their own constellation of stakeholders, as Mieg & Overmann state, we could

Fig. 3. Zeche Zollverein, Essen. UNESCO World Heritage since 2001 (image: Wikipedia).

distinguish between three main discourses: Heritage conservation, Urban Development and Architectural Production (Fig. 2).

1. Heritage conservation focuses mainly on the recovery and maintenance of the industrial facilities as well as the promotion of the immaterial cultural values associated with them. This approach is as little invasive as it can, just underscoring the built substance with punctual interventions; the results of this discourse are mainly for the museum purposes, but it can also yield goo results in for academic and teaching institutions. This could be the case of the Zeche Zollverein in Essen, or the Matadero de Madrid, which have embedded vibrant activities such as museums, libraries, academies, and multipurpose spaces in the industrial fabric.

2. Urban development's main drivers are not directly related with heritage conservation, they have more to do with city planning and economic and social development; This discourse will prime the feasibility and economic interests of the stakeholders, whether institutional or private.

An obvious conflict with existing industrial states will ensue, for these sites often find themselves in areas worth developing which cannot be fully exploited if the industrial heritage is to be preserved. The Falck Steel Mills in Sesto-San Giovanni is a good example of industrial sites which are planning to be redeveloped and intend to keep and reuse part of their remnant industrial heritage.

3. Architectural production can be seen as a branch of urban development, but it is focused on positioning "Star-architectures" in derelict areas with the intention of sparking initiatives which in turn will reverberate and complete the development. It also acts as a Laboratory for new forms of architecture that respond to new social issues, such as co-working spaces and adaptable housing solutions. This approach is somewhat down-to-top, in contrast to big masterplans being top-down, a good example of it being the Guggenheim in Bilbao, or the design-and gallery driven redevelopment of Hackney in London.

The UNESCO World Heritage Site Zollverein (Fig. 3) is probably an international best-practice model for the successful transformation of industrial sites. Since 1986, it has become a symbol of resilience as well as an extraordinary success story and a place symbolizing the bridge between heritage and future. It has successfully transitioned from smoking chimneys to an attractive cultural and economic hub, hosting a variety of uses ranging from museums and other cultural activities to university facilities.

German industrial and economic history was written in the the Zollverein region: In 1847, the entrepreneur and industrial pioneer Franz Haniel sank the first shaft in the northern part of Essen. Over the following 60 years, a total of eight shafts were built to exploit reserves of fat coal in the northern part of Essen. The last shaft complex of the Zollverein colliery was built between 1928 and 1932 against the backdrop of global efforts in mechanization and rationalization. When, on February 1, 1932, the wheels turned for the first time on the headframe above the new Shaft XII, an industrial high-performance complex with largely automated workflows came into operation, modelled on the principles of

Fordism, imported from America – thus, the assembly line production. The mine, centred around the 55-meter-high double headframe, was henceforth considered the largest and most powerful worldwide, above and below ground, up to 8,000 miners were employed in shift rotations, more than 600,000 people worked at Zollverein until its closure in 1986 [5]. Fritz Schupp (1896–1974) and Martin Kremmer (1894–1945) were tasked with designing the Zollverein Shaft XII colliery complex. The result was considered a technical and aesthetic masterpiece of modernity from the outset, achieved through close collaboration between engineers and architects. Additionally, Zollverein became a model colliery, meeting the representation needs of the owners, Vereinigte Stahlwerke AG, and attracting significant attention in the professional world from the outset. The architects articulated this aspiration in 1929: "We must recognize that industry, with its monumental buildings, is no longer a disruptive element in our urban landscape and countryside, but rather a symbol of work, a monument of the city, which every citizen should proudly show to strangers, just as they would their public buildings." (Brusis, 2000).

On December 16th, 1986, a week before closure, the unique ensemble of mining architecture was placed under monument protection, thus saving it from demolition. The preservation of Zollverein and other noteworthy monuments of the industrial era was part of the International Building Exhibition (IBA) Emscher Park, a ten-year (1989–1999) future program initiated by the state of North Rhine-Westphalia. The agenda included the transformation of large industrial areas in the northern Ruhr area, which had been dominated by coal and steel for almost 150 years: Zollverein became a flagship project. In 1989, the first phase of renovation for the repurposing of the halls and buildings began on Shaft XII, following the principle of "preservation through repurposing" (Hauser, 2001; Garcia, 2004; Miles, 2005). Among other developments, the former compressor hall was transformed into the Casino Zollverein in 1996, which still stands today as one of the most exceptional restaurant and event venues in the Ruhr area. In 1997, the Design Centre North Rhine-Westphalia moved into the former boiler house, which had been transformed by British

Fig. 4. Buildings of the Schacht XII, now Ruhr Museum, Zeche Zollverein Essen (picture: Brigida González, © Ruhr Museum).

architect Norman Foster into an extraordinary space for events and presentations. In 1999, Zollverein became the central anchor point of the newly created Route of Industrial Heritage – a 400-kilometer circular route that showcases the industrial heritage of the region for tourists.

Moreover, during this pioneer phase, it was primarily artists and creatives who discovered Zollverein as an inspiring place and occupied the first renovated halls. From 1992 to 1997, the sculptor Ulrich Rückriem used Hall 5 on Shaft XII as his studio and exhibition space. On the decommissioned mine site, he exhibited his works in 1992 as part of documenta IX, declaring the former colliery an external station of this world art exhibition – a novelty in the history of documenta. The designation of the decommissioned Zollverein colliery and coking plant as a UNESCO World Heritage Site in 2001 marked the beginning of further development of the entire site. Architect Rem Koolhaas, along with his Rotterdam-based Office for Metropolitan Architecture (OMA),

Fig. 5. Park Zeche Zollverein (https://www.die-planergruppe.de/project/der-zollverein-park/).

developed a master plan in 2002 for transforming the site into a vibrant cultural and economic hub. The conversion and expansion of the coal washing plant into an exhibition space for the Ruhr Museum and Ruhr Visitor Center (Fig. 4) in 2010 was the first significant transformation of the buildings.

By 2009, the number of visitors had gradually but steadily approached the million mark. In 2010, when the Ruhr area was the European Capital of Culture, the Zollverein World Heritage Site recorded a record number of visitors at 2.2 million guests [6]. Since then, 1.5 million tourists annually visit the Zollverein World Heritage Site (2011–2019). In addition to the growing number of visitors from other federal states and abroad – nearly two-thirds of visitors come from outside the region – the Zollverein World Heritage Site is also highly appreciated by residents of the Ruhr area as a destination: Zollverein has now become the most popular leisure destination in the entire region.

In 2017, the Zollverein Park took (Fig. 5) centre stage in the public eye, as the Zollverein World Heritage Site, alongside the Grugapark and Baldeneysee, was one of the three main venues of the "European Green Capital - Essen 2017." Through guided tours and events ranging from the Geo Day of Biodiversity to workshops and excursions, visitors learned about the transformation of the former industrial site into a roughly 70-hectare park with diverse industrial nature. Over 700 species of flora and fauna have been documented at Zollverein, including approximately 100 types of lichen, 40 bird species, and 20 different types of butterflies. Visitors have also been able to explore the unique features of the ecosystem at Zollverein through a free hiking map titled "Nature at Zollverein," which highlights twelve different stations.

The transformation of the Falck foundry, Milano Sesto San Giovanni

In 1906, Giorgio Enrico Falck founded his Società anonima Acciaierie e Ferriere Lombarde, and searched for a site to expand his business. The final choice fell on Sesto San Giovanni, a location that boasted several advantages: in addition to its proximity to Milan, it was crossed by an international railway line connected to the San Gottardo railway tunnel, allowing direct connections to France, Belgium, and Luxembourg, major centres for mining raw materials; it had abundant water sources necessary for iron production; and thanks to the connections provided by the Milan-Monza railway and the Milan-Monza tramway, it enjoyed good accessibility for labour. Furthermore, several other companies had already started production in Sesto San Giovanni, such as Breda, founded in 1886 and established in Sesto in 1903, Osva, founded in 1891, and Ercole Marelli, also founded in 1891 and established in Sesto San Giovanni in 1905 (Varini, 2006; Tedeschi & Trezzi, 2007; Trezzi 2007). The Unione plant is the first of Falck in the Lombard municipality, it was established in 1906 with the founding of the company and will always be the largest in the complex (Fig. 6). At its peak, the Unione plant covered 935,000 square meters.

Fig. 6. Ex acciaieria Falck Concordia, Sesto San Giovanni (https://commons.wikimedia.org/wiki/File:Ex_acciaieria_Falck_Concordia_01.jpg).

The Falck site is 1.5m sqm of brownfield, formerly a steel factory, covering approximately 13% of the whole municipal area. Despite its pollution and the heavy costs involved with land recovery, it occupies a strategic location within the north-east corridor of Milan-Monza as it sits in the midst of a dense urban area with connection to the northern and western ring highways. After the deindustrialization of the 1990s, large private corporations envisaged opportunities of residential and office development here. The area is also interesting for city government, as public returns from its development could increase supply of public services, social housing (1200 additional houses on a total existing stock of 2450 units), and scarce green spaces (Savini et al., 2015).
Since its closure in 1995, the redevelopment of the Falck industrial area has been subject to multiple initiatives for its development. As Fossa indicates (Fossa, 2015), there has been a cascade of developers offering masterplans, almost always signed by star-architects. In 1996 the Falck Family presented a Masterplan envisioned by Kenzo Tange, in 2001 the

Fig. 7. Masterplan of Sesto San Giovanni, Milan (image: © Foster & Partners and milanosesto).

developer Pasini bought the area and commissioned Mario Botta with a new planning, in 2005 the new ownership, Pasini & Coppola, asked Renzo Piano. In 2019 Hines commissioned Foster & Partners with the revision a development of a new concept for the Falck Area [7].
According to the developer [8], MilanoSesto, the largest urban regeneration project in Italy and one of the most ambitious in Europe, will transform an area of more than 1.5 million square meters into an efficient, sustainable, and inclusive urban centre. The masterplan designed by international architecture studio Foster + Partners (Fig. 7) foresees progressive development over the next few years with landscaping, multifamily residences for professionals and young families, new squares, retail and office spaces and, above all, places designed to connect people.

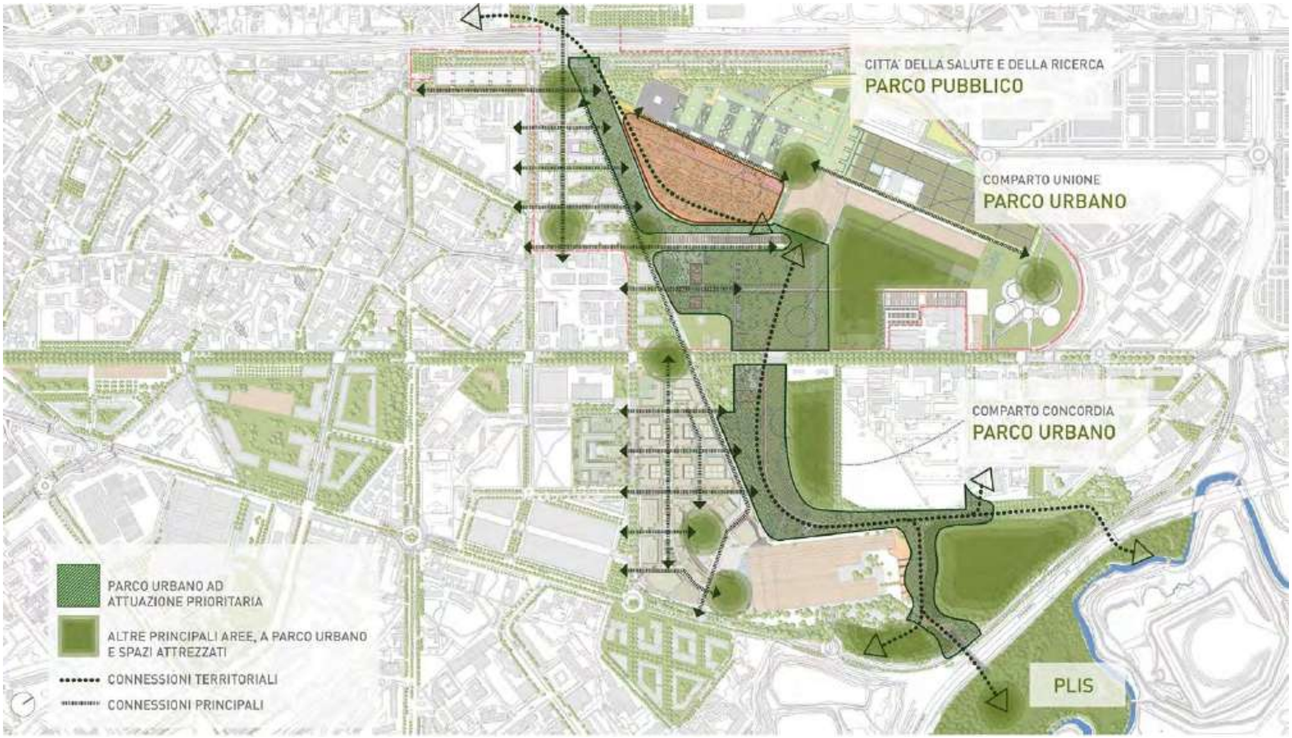


Fig. 8. The urban park in the Falck Area, as of 2019. The Masterplan from Renzo Piano is visible in the background (drawing: © milanosesto).

The area is well connected to the surrounding communities thanks to the new Sesto San Giovanni railway station (which work started in July 2021 and will take two years to complete), the subway station and the major trunk roads providing rapid access to the city centre, the toll ways and the rest of Lombardy. The area will also include a 45 hectare park (Fig. 8), an extensive green "lung" for the entire Milanese metropolitan area, integrated with the historic industrial buildings [9]. The large Urban Park of 2.5 hectares, together with the City of Health and Research Park and all the planned green areas and equipped public spaces, forms the heart of the emerging urban environment. The total extension of the green areas is over 50 hectares, with approximately 15 kilometers of cycling and walking paths and around 10,000 newly planted trees. The planned

Fig. 9. Proyecto de Ensanche de Bilbao, 1876. Alzola, Achúcarro & Hoffmeyer. Abandoibarra can be seen on the upper margin of the river Nervión (https://intranet.pogmacva.com/en/obras/49131#).

public areas occupy 75% of the total surface. The project involves the construction of a healthcare excellence hub, Città della Salute e della Ricerca (City of Health and Research), in addition to the new academic and hospital centre of the Vita-Salute San Raffaele University, and private spaces intended for residential facilities, offices, student residences, commercial space, and socio-cultural projects. The construction sites, opening at the start of 2022, are planned to close in 2032; in 2025 the first private lot (Union 0) and the City of Health and Research will be completed and put at the disposal of the community for use in 2025 [10]. A project of this scale and magnitude will generate impacts of a multiple nature for the local area. The investment planned for the construction of the first two lots - Union 0 and City of Health and Research will generate revenue of over 2.3 billion euros and over 5,300 jobs. At the end of the works, with the completion of the City of Health and Research and the creation of the residential and occupational hub, the true potential of regeneration will be unfolded. From an economic impact standpoint: people who will be using the spaces, that is, resident families, the city users who will be staying at the hotel, neighbourhood workers, patients and their families, etc., will generate almost 190 million euros of additional usage, every year. The Municipality of Sesto San Giovanni will benefit from an additional 2.6 million euros – in IMU, TARI property taxes and additional IRPEF income tax - an amount corresponding to 6.2% of total Municipality tax revenue [11].

More than economic aspects: student residences and flats rented at agreed rentals will have important social repercussions in an area where the availability of student accommodation is dramatically insufficient (there is a shortage of 30,000 beds to bring the city into line with the European average) and where the cost of rents makes it difficult for young people and couples to find adequate housing solutions without excessively overstretching their income. Thanks to the flats available at agreed rentals, which will be equipped with valuable services (study spaces, smart working, baby-sitting and fitness, etc.), 30% more residents in the neighbouring areas will be able to access a home at sustainable prices which will have an average cost 50% lower than comparable solutions in the Municipality of Milan. The project responds to nine of the seventeen Sustainable Development Goals (SDGs) set by the United Nations.

The Guggenheim Museum and the transformation of Abandoibarra, Bilbao

Bilbao, located in the Atlantic coast in the Gulf of Biscay, north of Spain, was until the 1990´s a typical example of a small city which grew prosperous on the wake of the industrial revolution and therefore suffered the consequences of the deindustrialization of the 1980. Abandoibarra, as the riverside of the city extension of the XIX century is known (Fig. 9), was the birthplace of one of the busiest shipyards in Spain, the Astilleros Euskalduna. Founded in 1900 as the Compañía Euskalduna

Fig. 10. Guggenheim Museum, Bilbao. Arch. Frank Gehry, 1996 (https://de.wikipedia.org/wiki/Guggenheim-Museum_Bilbao#/media/Datei:Guggenheim-bilbao-jan05.jpg).

de Construcción y Reparación de Buques, the shipyard took over the former docks of the Dry-Dock Company od Bilbao established 1868 and expanded over an area of 90.000 m2 which saw the construction and repair of ships over almost 90 years (Odriozola, 2011).

The oil-crisis of 1973 and the competition in the international market increased, especially with Asian builders from Japan and South Korea, leading to a decline in orders at European shipyards. Private capital gradually withdrew from the industry, leaving companies in the hands of the state. Spain's entry into the European Economic Community (EEC) compelled the sector to adapt to EU regulations, gradually reduce public subsidies, and open the Spanish market to European competition. However, in the 1980s, with industrial restructuring, the shipyards became the scene of 'the battle of Euskalduna,' which lasted for five years, from the announcement of the company's closure in 1983 until its consummation in 1988. During that time, the people of Bilbao became accustomed to seeing – and even crossing – the Deusto bridge in flames, the smell of burning tires, and the burning buses, as well as the bearings and screws launched with the rubber bands used by practitioners to draw blood, the rocket launchers made from tubes, and the rubber bullets and tear gas fired by the National Police dressed in brown. Previously, the great flood of 1983 had already started galvanizing the main urban stakeholders. The catastrophe brought together previously divided actors, whether from the city, the region, or the Spanish state (Crone, 2022). "The flood was Bilbao's Ground Zero," says Bernd Nitsch, architecture guide in the city and head of Guiding Architects Bilbao [12]. From then on, decision-makers agreed that the place needed more than just rebuilding; it needed a transformation. Under Ibon Areso, Bilbao's longtime chief planner, a master plan was developed in 1990. The core idea was to relocate the inner-city port in order to gain space in municipal ownership for the extensive redesign of the city centre. Public institutions established a development company, Bilbao Ría 2000, which still exists today, a public limited company constituted in equal parts by the State Administration, through companies dependent on it [13]. The active commitment of all the entities involved in BILBAO Ría 2000 has been maintained from the start of the company's activity and has allowed important urban transformation works to be carried out (Gonzalez, 2004). Between 1990 and 2000, the wasteland where once the shipyards stood has become a vibrant environment and the relationship between city and river has been re-established. Bilbao has undergone a period of radical change; it has a new metro system with sleek stations designed by Foster & Partners and two superb new library buildings. The city was completely rethinking its public spaces and a sophisticated contemporary culinary culture was emerging. Guggenheim Museum Bilbao opened in 1997 and has since been the symbol of the renaissance of Bilbao as well as its most visible face. Not only did the museum change the landscape of Bilbao by bringing millions of tourists from all over the world, but also gave name to the phenomenon known as the Bilbao Effect (Van Ryk, 2007), a term coined in the 2000's to describe the successful regeneration of cities. As Plaza puts it, the massive media attention generated by Frank Gehry's unique building, and the accumulation of news and images, repositioned the city of Bilbao globally (Plaza, 2006, 2022). The inclusion of an iconic building as a landmark within a Masterplan works wonders in the case of Bilbao, the appearance of the Guggenheim Museum (Fig. 10) with

Fig. 11. Liverpool, Piers Head. "The Three Graces". From left to right, Liverpool Pier Head, with the Royal Liver Building, Cunard Building and Port of Liverpool Building, and the Anglican cathedral in the background (https://en.wikipedia.org/wiki/Pier_Head#/media/File:Liverpool_Pier_Head.jpg).

its titanium sheeting and extravagant industrial forms symbolizes – partly representative, partly metaphorical – its bond with the tradition & heritage of the Euskalduna Shipyards (Haarich & Plaza, 2010). The museum is described in the academic literature as "one of the examples par excellence of an art museum originally conceived as part of an urban regeneration plan" (Baniotopoulou, 2001), and Bilbao becomes a "symbolic site of regeneration" (McNeill, 2000).

Bilbao has now become one of Spain's most captivating destinations for tourists and investors. The Guggenheim Museum's socio-economic impact more than met its objective of transforming the city's image, with calculations in 2017 suggesting that the museum generates around €400 million per year for the local economy [14]. A study of 2017 showed that since it opened in October 1997, the Guggenheim Museum has attracted some 7 million visitors, of whom 60 per cent are foreigners. It has contributed to the maintenance of approximately 4,500 jobs, principally in transport, hotels, restaurants, bars, coffee shops, and retail establishments; it has created added value amounting to more than €1.2 million, which has produced an increase in local fiscal capacity and tax revenues close to €200 million. Finally, the 'Guggenheim effect' has also been psychological: it has contributed to the recovery of civic pride. In

Fig. 12. Royal Albert Dock. Liverpool (https://en.wikipedia.org/wiki/Royal_Albert_Dock,_Liverpool#/media/File:Albert_Docks_Liverpool.jpg).

2022, the total demand generated as a result of the Museum's activity in the Basque Country was €448.8 million, and the contribution to the GDP was €393.4 million (with an additional income for the Basque Public Treasury of €60.9 million). The Museum's activity contributed to maintaining 8,410 jobs [15].

The case of Liverpool Maritime Mercantile City

Liverpool (Fig. 11) was in the XIX century the busiest port in England, and therefore the centre of trade of the British Empire, its activity and population grew strongly, from 100.000 in 1811 to nearly 850.000 in 1931 (9). By 1975, the population had almost decreased by 40%, to roughly 500.000 habitants. In 1981 the Toxteth Riots marked an inflexion pint in the history of Liverpool; similarly to Bilbao, high unemployment, and the misuse of "SUS" laws Vagrancy Act 1824 [16] had started riots in Brixton that quickly spread out to Toxteth in Liverpool (Jefferson, 1983). Then Secretary State of state Heseltine was named Secretary of the

Fig. 13. Liverpool Waters Development (image: © ARUP / Peel).

Merseyside launches regeneration initiatives for Liverpool, a heritage led campaign that started in 1983 with the refurbishment of the Royal Albert Docks (Fig. 12). These were built in 1846 as a fine example of innovation in the Dock Typology, with the warehouses constructed in Cast Iron and masonry all the way up to the Basin, so that the ships could be unloaded directly to the upper storeys (Jones, 2004). The restored buildings were opened to the public in 1988, now hosting a variety of uses such as the TATE Liverpool, Ground floor shops with office space on the mezzanine level and apartments on the remaining floors. The culture led development reached its peak in 2008, when it was chosen as European Capital of Culture, the Slogan "The World in one City" focused on the diversity and cultural traditions (music, literature, sports) of Liverpool.
In 2002, English Heritage announced the creation of the Historic Environment of Liverpool Project (HELP) in partnership with Liverpool City Council, the North West Development Agency, National Museums Liverpool, Liverpool Vision, and the Liverpool Culture Company. Among

Fig. 14. Liverpool Waters Development (drawing: © Chapman Taylor Architects).

its activities detailed studies of the city's built heritage and archaeology, as well as the design and implementation of a buildings-at-risk strategy, and a variety of educational and community projects, exhibitions, and publications could be found (Stonard, 2003; Rodwell, 2015).

The development of the nomination to UNESCO in 2002–2003, to which the HELP contributed substantively, formed a core part of the re-articulation of Liverpool as a world city for the 21st century. Liverpool Maritime Mercantile City was inscribed on the World Heritage List in 2004 under UNESCO criteria (ii), (iii), and (iv) [17]; the docks and their surviving urban landscape with the "Thee Graces" at the centre formed a 136 World Heritage Site with a 750 ha Buffer Zone around it. "They form a dramatic manifestation of Liverpool's historical significance ...[whose] vast scale... allows them to dominate the waterfront when approaching by ship" (Liverpool City Council, 2003a, 2003b). The pre-inscription 2004 ICOMOS advisory report described the nominated site as "a complete and integral urban landscape that provides coherent evidence of Liverpool's historic character and bears testament to its exceptional historical significance" (ICOMOS, 2004). By that time, the planned construction of a "Fourth Grace" (as an attempt to replicate the Bilbao Effect) next to the iconic trio of buildings at the Pier Head and the development of Mann Island close to the Royal Albert Dock was already a source of heavy discussion. Given that the United Kingdom planning system is both primordially negotiable and permissive in the interests of development, conflict with the international conservation community was going to be inevitable (Rodwell, 2015).

The city's determination to build at this location was the primary prompt for the 2006 UNESCO–ICOMOS mission which was followed by another in 2011. It led to the adoption of a new standard-setting instrument, the Recommendation on the Historic Urban Landscape (UNESCO, 2011b). The 2012 decision to place Liverpool on the List of World Heritage in Danger was founded upon the "soft law" of this 2011 Recommendation, which was not available previously. Key to this 2011 Recommendation is its definition: "The historic urban landscape is the urban area understood as the result of a historic layering of cultural and natural values and attributes, extending beyond the notion of a 'historic centre' or 'ensemble' to include the broader urban context and its geographical setting".

After the Museum of Liverpool and the Development of Mann Island were complete (winning Awards for the ugliest buildings in Britain), the site was inscribed on the List of World Heritage in Danger due to the proposed construction of Liverpool Waters project (Figs. 13,14). This is an aggressive development of the Waterfront north of the protected area but well into the Buffer Zone, which planned the construction of a 60 ha new district including Skyscrapers and a new Stadium for FC Everton. The eventual site is expected to contain a mix of residential, commercial, retail and sport facilities (Peel L&P, 2022).

The proposed plans are by no means fixed as they have been repeatedly redesigned over the years with a range of promotional images used to depict the hypothetical development. Like most large-scale developments, it is impossible to predict their final form as they undergo constant revision and adjustments depending on the success of each subsequent phase of the project along with more general factors such as the general

performance of the economy or the developers themselves.
In 2021 the World Heritage Committee, holding its 44th session in Fuzhou and online, decided to delete the property "Liverpool – Maritime Mercantile City" (UK) from the World Heritage List, due to the irreversible loss of attributes conveying the outstanding universal value of the property (UNESCO, 2021).
This case is of special interest not because of its success, which it had some, but for its conflict of interests and its clash with the UNESCO. There were some failures and some misunderstandings, It could be argued that the original UNESCO failed to represent clearly the implications of the Buffer Zone and that the reports of the ICOMOS Missions did not acknowledge directly the danger to the World Heritage Status deriving from the initial developments in Pier Head and Mann Island. According to Rodwell (2015), the conflict emerged in part from the initial state party's nomination referring to the value of the urban landscape but was clearly fueled by developers and politicians who had little interest in preserving the World Heritage Status. Instead of a heritage-led regeneration of the Docks north of Pier Head, which could have drawn in the identity of Liverpool and its unique characteristics, the Liverpool City Council and the Liverpool Waters development chose to transform the Waterfront into a speculative commercial mix of mid and high buildings that could be found anywhere else.

Notes
[1] European Charter of Fundamental Rights, 1948.

[2] As of April 2024, an agreement on banning forced labour products has benn reached in the EU, it is stilll pending approval by a full plenary of the European Parliament and the Council of member states. It is estimated that in 2021, almost 28 million people worldwide were in forced labour – 3 million more than in 2016. https://www.socialistsanddemocrats.eu/newsroom/agreement-reached-banning-forced-labour-products-eu-market-sds-flagship-proposal - seen on 24.April.2024.

[3] Statistics Finland (2007). From slash-and-burn fields to post-industrial society - 90 years of change in industrial structure, Statistics Finland https://www.stat.fi/tup/suomi90/helmikuu_en.html. – seen 24.April.2024.

[4] US Buro of statistics, 2024 . https://www.bls.gov/ooh/fastest-growing.htm - seen on 24.04.2024.

[5] Zollverein, https://www.zollverein.de/ueber-zollverein/geschichte - accessed 20.04.2024.

[6] Ibid.

[7] Milanosesto at the 2021 meeting in Rimini, https://www.milanosesto.it/assets/media/press/Press_release_MilanoSesto_Rimini_Meeting_2021_ENG.pdf - accessed 27.04.2024.

[8] https://ilgiornaledellarchitettura.com/2023/12/03/ex-falck-a-sesto-san-giovanni-la-patata-bollente-2/.

[9] Milanosesto: la rigenerazione urbana delle aree ex Falck. Attuazione della Variante al PII".

[10] Comune di Sesto San Giovanni e da Milanosesto SpA.
https://sestosg.net/wp-content/uploads/2020/01/6484-attach104.04.2019_Rigenerazione_Aree_ex20Falck_Lamiranda.pdf - accessed 27.04.2024.

[11] https://www.milanosesto.it/assets/media/press/Press_release_The_European_House_Ambrosetti.pdf.

[12] Ibid.

[13] https://www.bauwelt.de/rubriken/bauten/Die-Langzeitwirkung-des-Bilbao-Effekts-Guggenheim-Frank-Gehry-Baskenland-3850331.html - accessed 27.04.2024.

[14] SEPES- Public Business Land Entity-, Port Authority of Bilbao and ADIF, as well as by the Basque Administrations (Basque Government, Provincial Council of Bizkaia, Bilbao City Council and Barakaldo Town Council).
https://www.bilbaoria2000.org/en/bilbao-ria-2000/what-is-bilbao-ria-2000/ - accessed 27.04.2024.

[15] https://www.apollo-magazine.com/is-the-bilbao-effect-over-guggenheim/ - accessed 27.04.2024.

[16] Memoria de actividad 2022. Museo Guggenheim Bilbao. https://cms.guggenheim-bilbao.eus/uploads/2023/06/MEMORIA-de-actividad-2022.pdf - accessed 26.04.2024.

[17] Every suspected person or reputed thief, frequenting any river, canal, or navigable stream, dock, or basin, or any quay, wharf, or warehouse near or adjoining thereto, or any street, highway, or avenue leading thereto, or any place of public resort, or any

avenue leading thereto, or any street, or any highway or any place adjacent to a street or highway; with intent to commit an arrestable offence [...] shall be deemed a rogue and vagabond[.] —section 4, Vagrancy Act 1824.

[18] Criterion (ii): Liverpool was a major centre generating innovative technologies and methods in dock construction and port management in the 18th and 19th centuries. It thus contributed to the building up of the international mercantile systems throughout the British Commonwealth.

[19] Criterion (iii): the city and the port of Liverpool are an exceptional testimony to the development of maritime mercantile culture in the 18th and 19th centuries, contributing to the building up of the British Empire. It was a centre for the slave trade, until its abolition in 1807, and to emigration from northern Europe to America.

[20] Criterion (iv): Liverpool is an outstanding example of a world mercantile port city, which represents the early development of global trading and cultural connections throughout the British Empire.

References

Alzola, P., Achúcarro, S., & Hoffmeyer, E. (1876). *Memoria del Proyecto de ensanche de Bilbao, 1876*. (Introducción de Javier Cenicacelaya e Iñigo Saloña). Bilbao: Colegio de Arquitectos Vasco-Navarro, 1988.

Baniotopoulou, E. (2001). Art for whose sake? Modern art museums and their role in transforming societies: the case of the Guggenheim Bilbao. In J*ournal of Conservation and Museum Studies*, No. 7, pp. 1-15.

Beascoechea Gangoiti, J. M. (2007). Abando, el lugar del nuevo Bilbao. In F. Martinez Rueda (Ed.). B*ilbao y sus barrios: una mirada desde la historia*, Vol. I, pp. 47-65. Bilbao: Ayuntamiento de Bilbao / BilbaokoUdala.

Brusis, I. (2000). Industriedenkmale - Landmarken auf dem Weg in die Zukunft. In *Industriedenkmalpflege und Geschichtskultur Heft,* No. 1, pp. 22-24.

Cenicacelaya, J. (1999). El ensanche de Bilbao de Alyola, Achúcarro y Hofmeyer de 1876. In *Ciudad y Territorio. Estudios Territoriales*, Vol. XXXI(119-120), pp. 307-316. Ministerio de Fomento, Madrid.

Crone, B. (2022). Die Langzeitwirkung des Bilbao-Effekts. In *Bauwelt*, No. 235, pp. 66-69. Bauverlag BV GmbH, Berlin.

Finkenzeller, K. (2007). Mal Guggen, Die Zeit, 04.10.2007 Nr. 41. <https://www.zeit.de/2007/41/Bilbao/komplettansicht > (accessed 27 april 2024).

Garcia, B. (2004). Cultural policy and urban regeneration in Western European cities:

lessons from experience, prospects for the future. In *Local Economy*, No. 19.4, pp. 312-326.

Gonzalez, S (2004). The role of the Guggenheim Bilbao Museum in the development of urban entrepreneurial practices in Bilbao. In *International Journal of Iberian Studies*.

ICOMOS (2004). *Advisory body evaluation: Nomination of Liverpool – Maritime Mercantile City*. Paris: ICOMOS.

Haarich, S., & Plaza B. (2010). Das Guggenheim-Museum von Bilbao als Symbol für erfolgreichen Wandel – Legende und Wirklichkeit. In U. Altrock, S. Huning, T. Kuder, H. Nuissl, D. Peters (Eds.). *Symbolische Orte. Planerische (De-)Konstruktionen. Reihe Planungsrundschau 19*. Berlin.

Hauser, S. (2001). *Metamorphosen des Abfalls: Konzepte für alte Industrieareale*. Frankfurt : Campus Verlag.

Ibañez, I. (23.12.2023). El Puente de deusto en llamas: 40 años de la batalla de astilleros Euskalduna. *El correo* <https://www.elcorreo.com/bizkaia/puente-deusto-llamas-anos-batalla-astilleros-euskalduna-20231203013342-nt.html> (accessed 27 april 2024).

Jefferson, M. (1983). The Toxteh Riots: a selected bibliography. Liverpool Law Rev, 5, pp. 203-218.

Jones, R. (2004). *The Albert Dock, Liverpool*. RJ Associates Ltd.

Liverpool City Council. (2003a). *Nomination of Liverpool – Maritime Mercantile City for inscription on the World Heritage List*. Liverpool: Liverpool City Council.

Liverpool City Council. (2003b). *Liverpool – Maritime Mercantile City: Management plan*. Liverpool: Liverpool City Council.

McNeill, D. (2000). McGuggenisation? National identity and globalisation in the Basque country. In *Political Geography*, No. 19, pp. 473-494.

Mezzi, P. (2023). Ex Falck a Sesto San Giovanni, la patata bollente. <https://ilgiornaledellarchitettura.com/2023/12/12/ex-falck-a-sesto-san-giovanni-la-patata-bollente-3/> (accessed 27 april 2024).

Mieg, H. A., & Overmann, H. (2015). *Clash of discourses*. Routlegde: Cambridge Mass.

Miles, S. (2005). 'Our Tyne': iconic regeneration and the revitalisation of identity in Newcastle-Gateshead. In *Urban Studies*, No. 42.5–6, pp. 913–26.

Moro, A. (2016). *Ex Area Falck. Idee e progetti nel tempo*. Milan: Mimesis.

Nieva, A. M. (18 January 2018). Ellegado portuario, presente en la transformación de

Bilbao. PORTUS the online magazine. <https://portusonline.org/el-legado-portuario-presente-en-la-transformacion-de-bilbao/> (accessed 27 april 2024).

Odriozola Oyarbide, L. (2011). La Compañía Euskalduna de Construcción y Reparación de Buques. <www.euskomedia.org.> (accessed 27 april 2024).

Peel, L&P. (2022). The Neighbourhoods. <https://liverpoolwaters.co.uk/about/> (accessed 2 september 2022).

Plaza, B. (2006). The return on investment of the Guggenheim Museum Bilbao. In *International Journal of Urban and Regional Research*, Vol. 30, No. 2, pp. 452-467.

Rodwell, D. (2015). Liverpool: Heritage and Development—Bridging the Gap?. In M. Overmann (Ed). *Clash of discourses*, pp. 29-46. Routlegde: Cambridge Mass.

Savini, F., Majoor, S., & Salet, W. (2015). Urban peripheries: reflecting on politics and projects in Amsterdam, Milan, and Paris. In *Environment and planning C: Government & policy*, Vol. 33, No. 3, pp. 457-474.

Schwab, K. (2017). *The fourth industrial revolution*. London: Penguin.

Tedeschi, P., & Trezzi, L. (2007). *L'opera condivisa, La città delle fabbriche, Sesto San Giovanni (1903–1952). La società*. Milano: Franco Angeli.

Trezzi, L.(2007). *Sesto San Giovanni (1953–1973). Economia e società: equilibrio e mutamento*. Milano: Skira.

UNESCO (2021). Summary Record of 44th session of the World Heritage Committee Fuzhou (China) WHC/21/44.COM/INF.19.< https://whc.unesco.org/archive/2021/whc-21-44com-inf19-Summary-Records.pdf> (accessed 27 april 2024).

UNESCO (2011b). *Recommendation on the historic urban landscape*. Paris: UNESCO.

Van Ryk, N. (6 october 2007). The Bilbao-Effekt. Welt Print. <https://www.welt.de/welt_print/article1239862/Der-Bilbao-Effekt.html> (accessed 27 april 2024).

Vanstiphout, W. (6 January 2012). What's wrong with managed decline?. Building Design, No. 9. < https://www.bdonline.co.uk/opinion/whats-wrong-with-managed-decline/5029986.article> (accessed 27 april 2024).

Varini, V. (2006). *L'opera condivisa, La città delle fabbriche, Sesto San Giovanni (1903–1952), L'industri*a. Milano: Franco Angeli.

Inhabiting the Industrial Heritage. Rehabilitation of Industrial Areas into Collective Housing

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Introduction

Industrial heritage has acquired a meaning that exceeds the aesthetic or testimonial to become a temporal and spatial framework in the memory of place. The contemporary interpretation of the concept of "heritage" recognizes the need to define traditions and identities and makes necessary a professional and institutional system of conservation with an urban dimension (Bandarin & Van Oers, 2012, p. 15). The Italian architect and urban planner Gustavo Giovannoni (Zucconi, 1997), who in the 1930s laid the foundations for the conservation of urban heritage, by proposing the protection not only of the monument but also of its surroundings, integrating contextual needs under a global vision, is a precursor of this meaning of the term. The landscape values of the industrial traces, the urban heritage and the needs of the city and the population, join the values of each work in a continuous space, which conditions its conservation and use in a second life.

Since the 1960s there has been a growing interest in industrial archaeology, first in Great Britain and the rest of Europe, and later in countries on other continents. It is a utilitarian architecture, sometimes influenced by the dominant neoclassical trends in the first half of the nineteenth century, which determines the appearance of decorative elements. Initially they were built with the available materials, which conditioned the design, essentially affected by the energy used, and new materials were introduced, such as cast iron in structural elements. Indeed, the evolution

Fig. 0. Alliance Building at the Gasworks, Dublin, Ireland. O'Mahony Pike Architects. Housing Project, 2006 (source: O'Mahony Pike 2006, p. 71).

of industrial buildings is strongly influenced by technical progress, the availability of materials, stylistic change in architecture and the demands of production cycles, specific to each industry (Capel, 1996, p. 25).

The technological obsolescence of installations has led to a loss of the primitive function of industrial facilities, and, from the production point of view, the modern city has undergone a series of important changes in its organization. The processes of industrial reconversion and restructuring, linked to the crisis of the 1970s and the global displacement of industrial employment from traditional regions to new ones, have led to the abandonment of industrial land in strategic urban areas of European cities, leaving a large number of production spaces outdated and unused. In parallel, there has been a growing phenomenon of tertiarization of the so-called post-industrial city, which has conditioned the reuse of industrial buildings to accommodate other uses (Biel Ibáñez, 2016, p. 159).

There is a wide range of approaches and criteria that have been adopted in the reuse of industrial architecture, after its late identification as heritage to be preserved. The disappearance of unique works such as Les Halles in Paris (Victor Baltard, 1852-1870), demolished between 1971 and 1973, led to the inventorying and cataloguing of this type of architectural ensembles, which began to be recognized and protected (Hernández, 2013, pp. 29-30). Parallel to this awareness, the first interventions were carried out on this functionally obsolete architecture, which needed a new use, as a means to guarantee its survival.

This chapter focuses on industrial heritage reuse processes in which collective housing projects are carried out. They find their precedent in pioneering examples such as: The Blue Warehouse, Copenhagen, Denmark (Hertz & Ramsgaard Thomsen, 1979); Water Toren Wej, Rotterdam, The Netherlands (Wytze Patijn, 1982); Riverhead Granaries, Humberside, England (MacCormack and Jamieson, 1979); Buchanan Wharf, Bristol, England (Halliday Meecham, 1988); Bryant & May match factory, London, England (ORMS Architects, 1988); or Spillers & Bakers warehouse, Cardiff, Wales (MWT Architects, 1988).

The paper presents various contemporary European cases and experiences in the conversion of industrial heritage into residential complexes, which allow us to analyze how these actions affect the architecture and its surroundings, depending on the diversity of areas that affect each strategy: factors such as artistic value, symbolic character, municipal requirements, neighborhood initiatives, the sensitivity of the intervening agents and the possibilities offered by their reuse.
This selection of case studies has been structured according to the building typology of industrial, agricultural, and port constructions, depending on whether they are:
- Warehouses, with linear porticoed structure.
- Silos, with wall structure by aggregation of modules.
- Gasometers, with circular perimeter wall or lattice structure.

These are operations with central or peripheral locations, in which social, student or luxury housing projects are carried out, but in any case, they are archetypes of regions with remarkable traces of the industrial revolution, which serve to illustrate the limits and possibilities of their reconversion into urban residential complexes.

Warehouses

Jernstøberiet, Roskilde, Denmark. Jan Gudmand-Høyer and Jes Edvars Architects. Co-housing Project, 1980

Jernstøberiet in Roskilde, Denmark, is a cohousing community designed by Jan Gudmand-Høyer and Jes Edvars in 1980, in a former iron foundry. Located in the Himmelev neighborhood, in an environment of traditional single-family houses, the factory was reconverted, after a long process of rehabilitation, into a housing complex with common uses that favored the social interaction of the residents. According to Jan V. Hansen, this is the Third Generation community with the most radical and innovative approach so far (Gudmand-Høyer & Edvars 1984, p. 234).
The factory consisted of a large production nave with a gable roof and a maximum height of 8 m., and adjoining naves with a pitched roof and side skylights. Jernstøberiet took up a project from 1968, structured

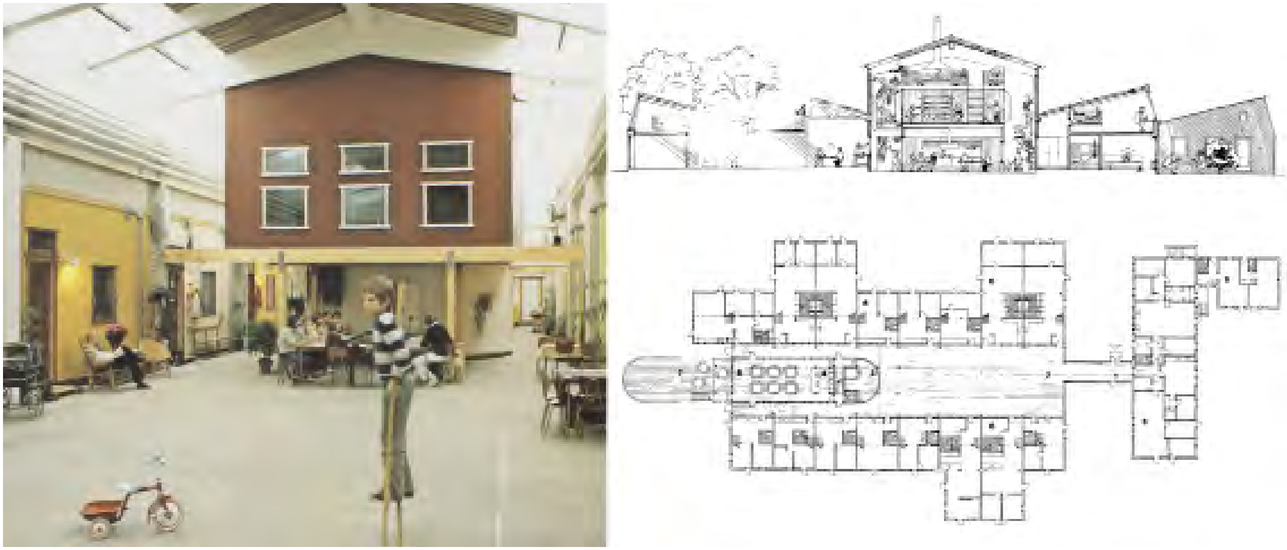

Fig. 1. Jernstøberiet, Roskilde, Denmark. Jan Gudmand-Høyer and Jes Edvars Architects. Co-housing Project, 1980 (source: Gudmand-Hoyer and Edvars 1984, pp. 236, 237).

around a glazed central street. The central nave took on the character of a covered outdoor space and an entrance hall for 20 apartments located in the side naves and in an annexed volume. This common area is the physical center of the community, providing a place for informal gatherings and children's games, and acting as a climate buffer (Fig. 1). At one extreme, a community center with shared kitchen, dining room, lounges, workshops, etc., was set up with more intensive treatment. The dwellings of between 33 and 127 square meters for singles and families, involve the segmentation of the warehouses with a single module and the use of the section with mezzanines and light entrances on the roof, which compensate for the great depth of the bays. They are open to the environment with small individual gardens, and large outdoor spaces with playgrounds, fields, and orchards. The rehabilitation of the original architecture was approached with minimal modifications and criteria of economy and self-construction by the residents, through the reuse of the roofs and the enclosure, which was covered with wood planking and corrugated iron, thus guaranteeing the viability of the project.

Torpedo Boat Workshop, Copenhagen, Denmark. Vandkunsten Architects. Housing Project, 2003

The old Torpedo Boat Workshop located in the port of Copenhagen, Denmark, currently accommodates a housing complex designed by Vandkunsten architects in 2003. The building was built in 1954 for the repair and maintenance of Navy vessels, in Holmen, the Royal Naval Shipyard, an area of important natural and architectural value, selected after its abandonment in the 1990s for the urban development of the city. In the renovation, the gigantic 160x32x15 m. structure of reinforced concrete porticoes every five meters and steel trusses was preserved, in memory of the building's unique architecture, and took on a new meaning. Under the trusses, a public passageway open to the sky runs longitudinally through the building, extending the street to provide access to the dwellings, facilitate relations between residents and, ultimately, integrate the complex into the city. One end rises up to the second floor, above a communal parking lot that facilitates vehicular access, and the other end goes into the canal, allowing access from the water. This dynamic and vibrant interior street is bordered and crossed in height by light footbridges and terraces of the dwellings, recalling the activity of the old shipyard hall (Fig. 2).

The 67 bright and flexible loft apartments of 75 to 275 square meters, on one or two floors, open with large windows and terraces to the interior street and to the surroundings, leaving the slender trusses on the penthouses visible (Keiding, 2003, pp. 234-241). Its self-supporting modular system is integrated into the fabric of the structure, set back 40 centimeters from it, to maintain its independence and prominence.

Massó i Carol - Vapor Llull Factory, Barcelona, Spain. Cristian Cirici and Carles Basó Architects. Housing Project, 1997

The Massó i Carol - Vapor Llull chemical factory located in Barcelona, Spain, was rehabilitated with a private residential project by Cristian Cirici and Carles Basó architects in 1997. The factory, inaugurated in 1902 and in service until the end of the 1990s, is located in Poble Nou, a traditionally

Fig. 2. Torpedo Boat Workshop, Copenhagen, Denmark. Vandkunsten Architects. Housing Project, 2003 (source: Keiding 2003, pp. 235, 237).

industrial neighborhood, which protected this type of building through a Special Plan for its progressive reconversion and integration into the city (López, 2011).

It is a complex that houses a main longitudinal nave with three floors, different auxiliary buildings, and a 32 m. high solid ceramic brick chimney, which was preserved. The building maintained its original structure with three floors, solid brick load-bearing perimeter walls, intermediate pillars and cast-iron beams, ceramic vaulting and a gabled roof with wooden trusses. In the intervention, the building was subdivided with vertical partitions of exposed brick into 18 independent and double oriented modules of about 90 square meters, intended for workshops, offices, studios, and housing (Martí et al., 2000, p. 4). The free height on the

ground and second floors allowed the incorporation of an intermediate slab, and each unit was left unfinished so that users could adapt it to their preferences and needs.
Three vertical cores with stairs and elevator were added to the existing building, which were supported on the envelope, signifying the exterior with volumes of sheet metal and glass. Together with the color treatment on the façades based on silicate paint that replaced the pre-existing plaster (Broto & Mostaedi, 2006), these light volumes contributed to change the original image, signifying the accesses from a communal garden space in which a parking lot is integrated in an independent volume (Fig. 3).

Passatge del Sucre Factory, Barcelona, Spain. Garcés - De Seta-Bonet Architects. Housing Project, 2009
Located in the same neighborhood of Poble Nou in Barcelona, Spain, Passatge del Sucre is a former alcohol distillery rehabilitated with a collective housing project by Garcés - De Seta - Bonet architects in 2009. It was covered by a new typology of municipal ordinances, called "unconventional housing" which, as happened in the 1960s in New York, allowed transforming industrial buildings with architectural, historical or artistic interest into "lofts" (Dot Jutgla & Pallares-Barbera, 2015).
This old industrial complex of 1916 consisted of three warehouses with a gable roof and two blocks in height, arranged in an L-shape and structured by a central access passage (Garcés et al., 2015). The three naves had load-bearing façades of facing brick, cast iron pillars and beams, intermediate slab of ceramic vault and gable roof, with metal and wood trusses. Given the limited natural ventilation surface and the difficult access to the two naves perpendicular to the passageway, a corridor was opened with the partial demolition of one of them, maintaining the metal trusses that recall the original volume (Fig. 4). Taking advantage of the clear heights, in one of the bays the original floor slab was replaced by two new ones, and in the others, it was maintained, with occasional interventions and mezzanines on the upper level. In the blocks, the cast iron pillar structure was preserved or reinforced with concrete pillars, incorporating an

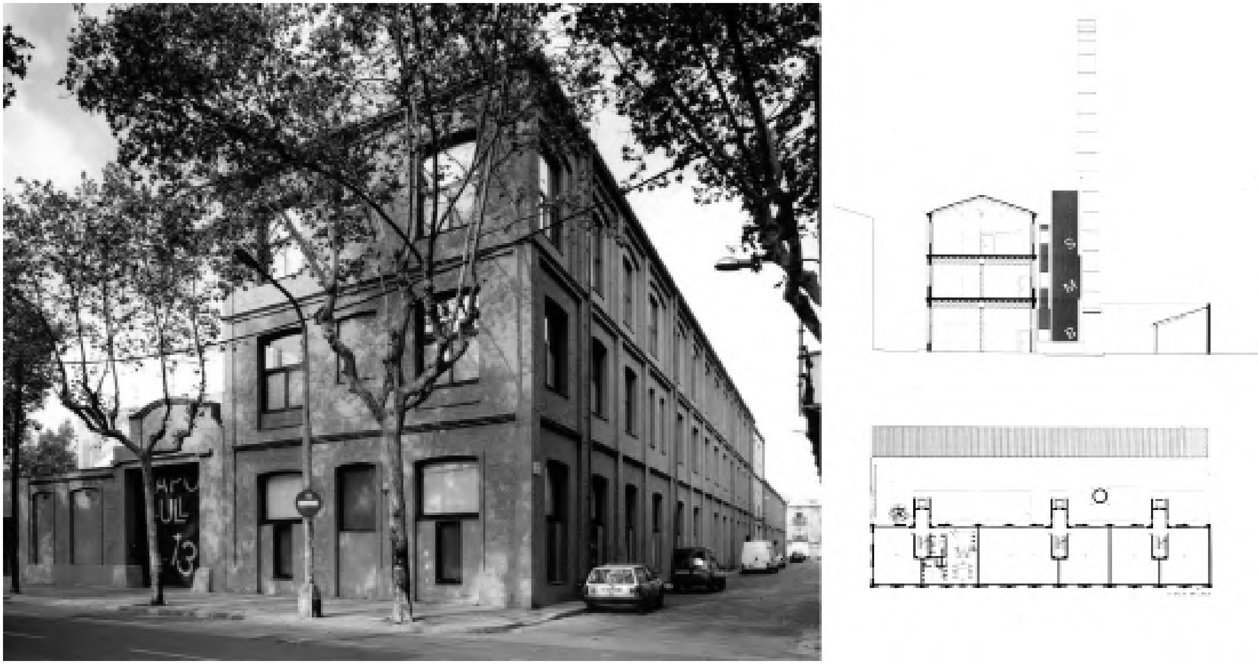

Fig. 3. Massó i Carol - Vapor Llull Factory, Barcelona, Spain. Cristian Cirici and Carles Basó Architects. Housing Project, 1997 (source: Broto and Mostaedi 2006, p. 45).

intermediate slab and favoring the connection with the street by emptying the ground floor. The complex houses 29 dwellings with very different typologies and surfaces, which, due to the characteristics of the building, are unique and exclusive (Laudy, 2011, pp. 27-29).
The project included important variations in the façade, maintaining some windows and opening others with metal lintels. The differentiation of the facings, completed with a new type of brick, allows us to guess the original composition, in a collage of overlappings.

Fabra & Coats, Barcelona, Spain. Roldán and Berengué Architects. Social Housing for Young People Project, 2005

Fabra & Coats is a former textile industrial site of about five hectares, founded in 1837 in the district of Sant Andreu in Barcelona, Spain, which after its closure in 2005 was acquired and protected by the City Council to

Fig. 4. Passatge del Sucre Factory, Barcelona, Spain. Garcés - De Seta - Bonet Architects. Housing Project, 2009 (source: Garcés 2015, pp. 233, 235).

reconvert it into facilities for the city. One of the yarn storage warehouses, built in 1905, was converted by Roldán and Berengué architects into social housing for young people under municipal management.

The building measures 100x15x11m. with a solid brick façade and 25 bays with steel structure and trusses on the roof, and an intermediate concrete slab. With the intervention, the longitudinal dimension is emphasized, by making a central emptying of the building, where the access and the itineraries are concentrated by double diagonal ascending stairs. This cascading community space functions as an interior plaza, which physically and visually communicates all levels (Fig. 5). The 46 housing modules of about 60 square meters, built with timber framing, are inserted into the original structure, which makes it possible to generate two intermediate floors, increasing from two to four, without the need for reinforcements, given the lightness of the material. They are separated from the roof and both façades with intermediate spaces that, in addition to functioning as

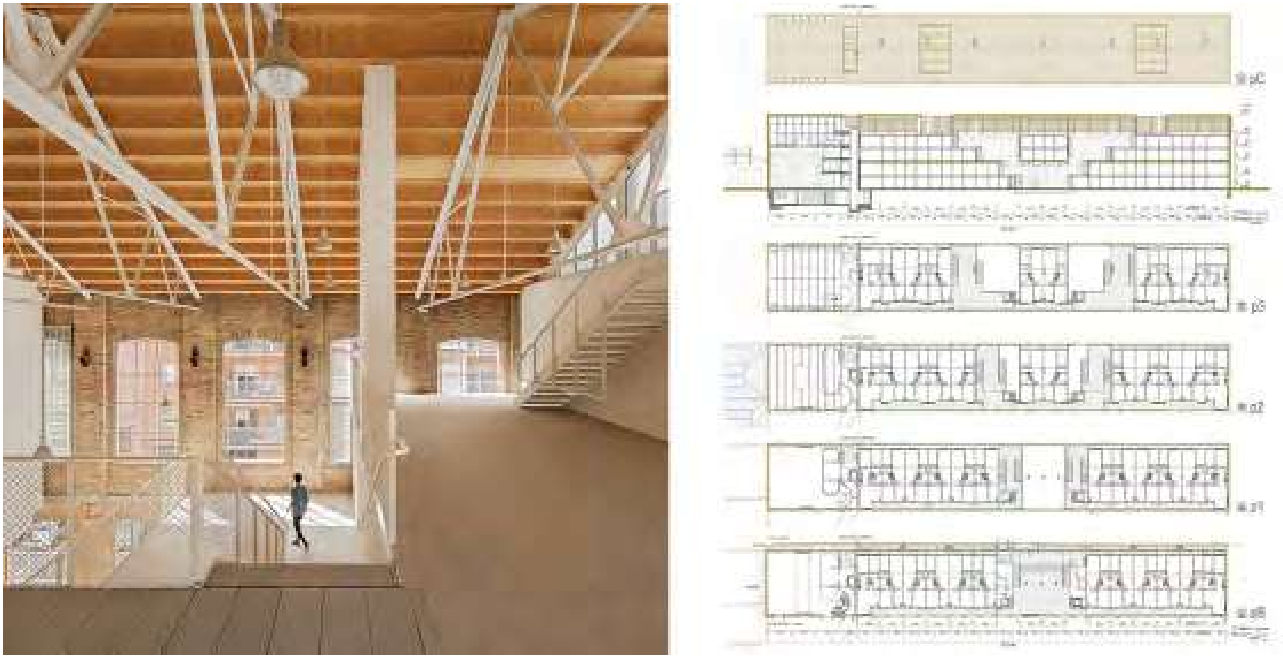

Fig. 5. Fabra & Coats, Barcelona, Spain. Roldán and Berengué Architects. Social Housing for Young People Project, 2005 (source: Roldán and Berengué 2020a, pp. 162, 165).

a thermal buffer, optimized by the inertia of the original construction, allow the organization of accesses and terraces.
The new construction, by its nature and assembly, can be mounted and dismounted, so it is "reversible", allowing the nave to be returned to its original state if necessary. The project is based on "activating all the elements of the original building for the new program", as well as reusing its physical, spatial, and historical qualities, to make the new construction more efficient and reinforce the nature of the original building (Roldán & Berengué, 2020a, 2020b).

Silos

Grain Silo in Grünerløkka, Oslo, Norway. HRTB Architects. Student Housing Project, 2002

In the Grünerløkka district of Oslo, Norway, a grain silo next to the

Aker River was transformed into a student residence by Ola Mowé, Ketil Moe, Kjell Beite and Harald Lone architects (HRTB) in 2002 as part of a larger-scale urban regeneration program. The riverbed, an engine of the city's industrial development since the 18th century, was declared a nature park in the 1990s, with rezoning of the industrial buildings to residential, university and artistic use (HRTB 2002, 2003, 2004).

The grain deposit, erected in 1953, was the first Norwegian building constructed in reinforced concrete with sliding formwork, which formed 21 cylindrical hoppers. The adaptation to the new use follows the criterion of reducing the construction effort and preserving the singular character of the building, respecting its rounded geometry. Slabs are inserted on 16 floors and a distribution corridor is generated by perforating the central hoppers. The 226 units occupy segments of a circle, circular main spaces and interstices between the hoppers, where the bathrooms are located (Fig. 6). On the upper floor, there are common spaces and services and a rooftop viewpoint.

The structure is perforated with more than a thousand vertically proportioned openings. Inside, the concrete is exposed and dialogues with a color code designed by Lykke Frydenlund, which extends to the glass sills of the balcony windows and the furniture adapted to the curvatures. To the exterior, a layer of thermal insulation is projected, protected by a crude rendering, to maintain the original roughness. The transformed building stands as a monument and icon of the urban landscape and of the surrounding redevelopment (Burnham, 2018, pp. 71-73).

Frøsilo, Copenhagen, Denmark. MVRDV Architects. Housing Project, 2005

The Frøsilo is a radical housing project for the conversion of two identical cylindrical silos, almost next to each other, located in the old harbor of Copenhagen, Denmark, realized by Winy Maas, Jacob van Rijs and Nathalie de Vries architects (MVRDV) in 2005. The intervention in these old silos of bare reinforced concrete and incomplete appearance was based on their main limitation, the difficulty of drilling their continuous structure.

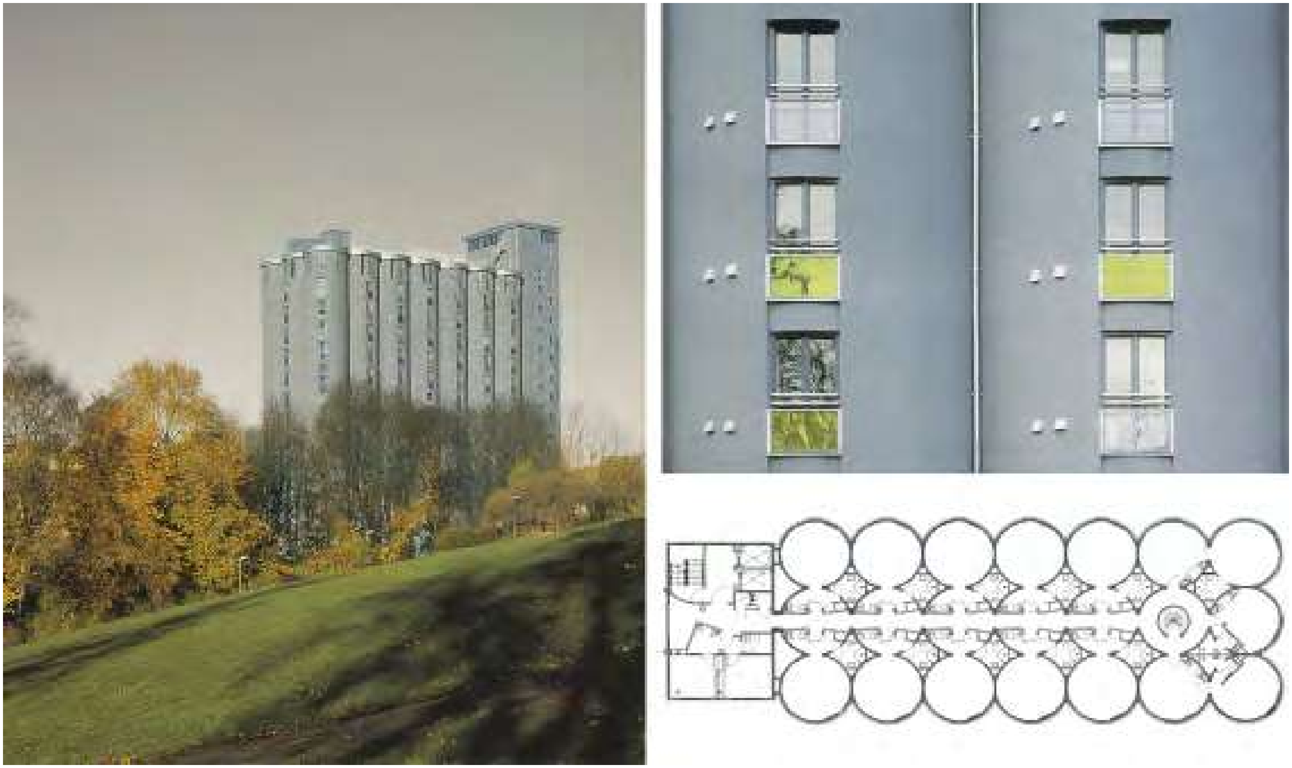

Fig. 6. Grain Silo, Grünerløkka, Oslo, Norway. HRTB Architects. Student Housing Project, 2002 (source: HRTB 2002, pp. 111, 113).

Given their nature, in the concrete cylinders it was only possible to make restricted openings of complicated execution, which was an excessive constraint to locate the dwellings inside. On the other hand, it would mean losing the most attractive aspect of their original state, the quality of emptiness. Thus, the silos literally form the new cores of the project, with perimeter distribution rings on each floor, which allow access to the apartments through punctual holes in the structure, stairs in flight, which go into the void, and elevators and ducts, which turn them into server shafts. Both cores are covered and protected with a transparent plastic membrane roof that allows a glimpse of the sky, giving rise to a futuristic lobby that shows the movement of the users (Fig. 7).

To the outside of the silos, 8 floors are suspended with 84 apartments made up of continuous curved spaces, which make it possible to dispense with intermediate walls, providing maximum flexibility. The cylinders are enveloped in a light and transparent glass skin, bordered by wide continuous terraces, which allow to enjoy the privileged panoramic views over the port and achieve a total transformation of the original infrastructures (MVRDV, 2005).

Grain Silo, Copenhagen, Denmark. COBE Architects. Urban Facilities and Housing Project, 2017

The Silo in Copenhagen, Denmark is a former port grain container redeveloped by COBE architects with a luxury urban facilities and housing project of private initiative in 2017. It is located in the Nordhavn district, where the 19th century docks have been immersed since 2009 in a process of transition to a modern residential neighborhood for 40,000 people, with the preservation of its identity and industrial heritage (Lindhardt Weiss, 2018).

The silo, built at the end of 1950 with rigorous criteria of functionality and economy, was a slender block formed by 27 concrete square-shaped tubes, which constituted a focal point in the port due to its great visibility. It had a structural mismatch, as it was slightly twisted, so it had to be calibrated with a careful process. To open up and articulate its thick exterior walls, a façade was designed to relate to the original structure. Galvanized steel caissons were attached, enveloping the building with a new faceted shell. The shape of these high-precision prefabricated modules allows balconies to be sheltered and drafts to be deflected to make the ground floor habitable, and they form an efficient sculptural "cladding" that flickers and shimmers in the light (Fig. 8).

Inside, the concrete remained exposed, even showing its cross-section in the openings between rooms. It contains 39 exclusive apartments of one or more levels and 73 to 305 square meters, which were adapted to the heights of the existing floors up to 8 m. Both the first floor and the upper level are publicly accessible, with a gallery that generates activity

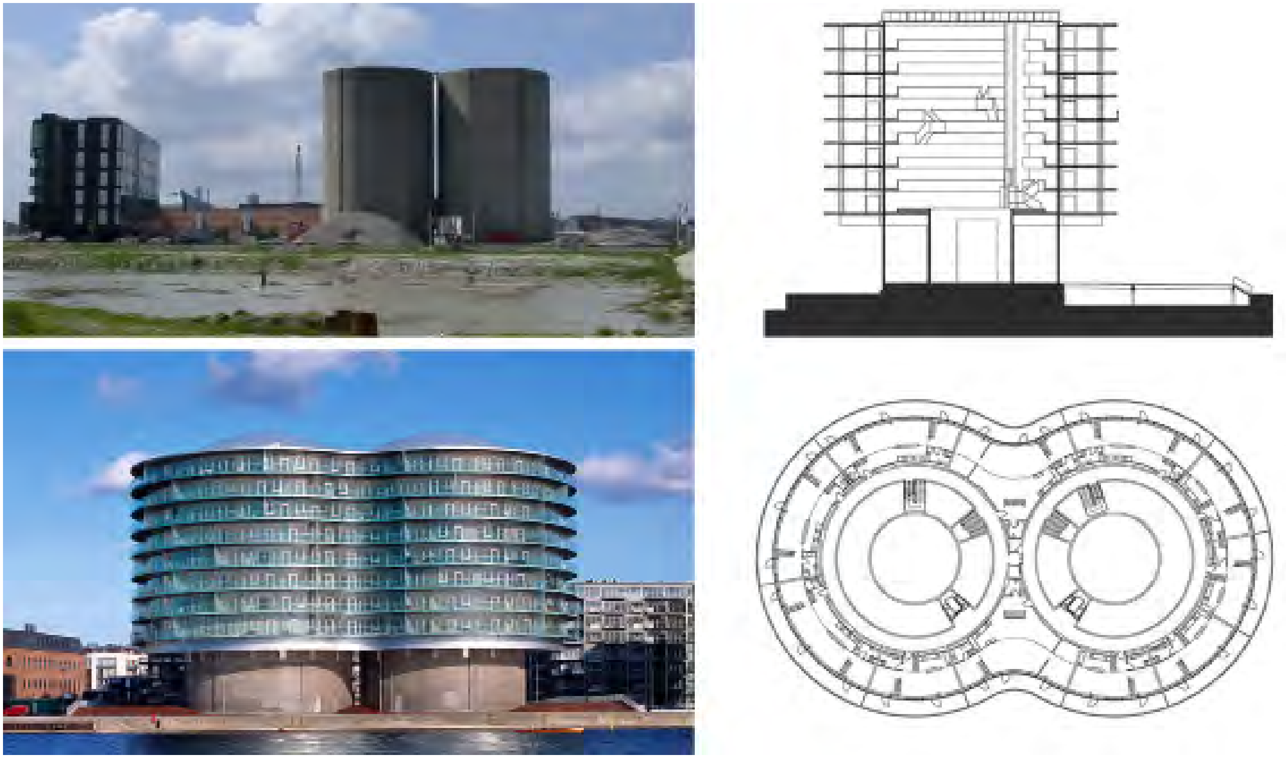

Fig. 7. Frøsilo, Copenhagen, Denmark. MVRDV Architects. Housing Project, 2005 (source: MVRDV 2005, p. 14).

towards the street and a restaurant wrapped in a glass skin, which finishes the silo with a luminous halo. The Silo aims to preserve the monolithic spirit of the old building, derived from the materiality and tactility of its construction, by simply covering it with a new cladding (COBE 2017, 2019).

Gasometers

Gasometers in Simmering, Viena, Austria. Jean Nouvel, Coop Himmelb(l)au, Manfred Wedhorn and Wilhelm Holzbauer Architects. Urban Facilities and Housing Project, 2001

The transformation of four gasometers located in the industrial district of Simmering in Vienna, Austria, responds to the initiative in 1995

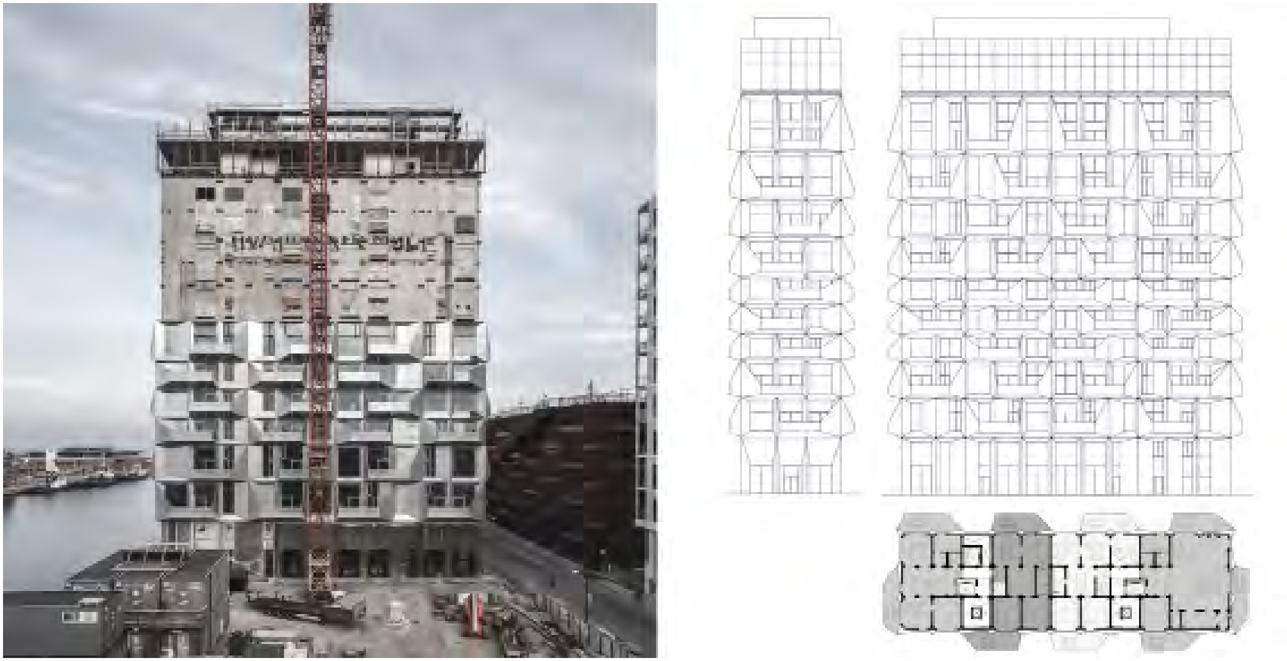

Fig. 8. Grain Silo, Copenhagen, Denmark. COBE Architects. Urban Facilities and Housing Project, 2017 (source: Lindhardt Weiss 2018, pp. 152, 158).

to preserve their heritage value by holding a competition for a mixed program. In 2001, the project by Jean Nouvel, Coop Himmelb(l)au, Manfred Wedhorn and Wilhelm Holzbauer architects for the conversion of the deposits into housing and offices was completed with a common base with a shopping center, cinemas, and concert hall, designed by Rudiger Lainer, which facilitated their integration into the surroundings (Wehdorn, 2002, pp. 86-89).

The gas factory, built between 1896 and 1899, was the largest complex in Europe, responsible for supplying the city until 1970. The four preserved tanks, 72 m. high and 64 m. in diameter, are of telescopic type and brick masonry with classic style openings, stiffened on the outside with large pilasters. The introduction of apartments and offices in each of these structures was based on the existing geometric order, with the premise of preserving them, reinforced with concrete pillars and rings, integrating


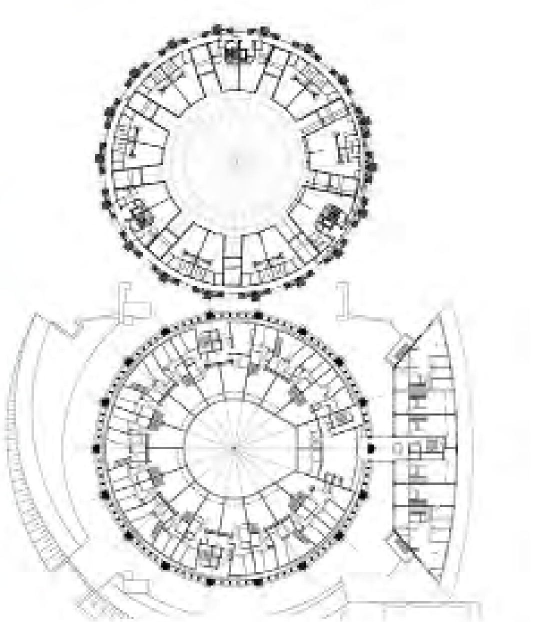

Fig. 9. Gasometers in Simmering, Viena, Austria. Jean Nouvel and Coop. Himmelb(l)au Architects. Urban Facilities and Housing Project, 2001(source: Nouvel, 2001, p. 48; Wehdorn 2002, p. 86).

new materials and styles. Jean Nouvel divided the gasometer A into nine segments located on the perimeter with 200 housing units, separated from each other and independent of the envelope by an exterior corridor. These volumes, clad in stainless steel, allow a view of the ceramic wall and reflect light, contributing to the luminosity of the central courtyard (Nouvel, 2001, pp. 48-51) (Fig. 9).

Coop Himmelb(l)au incorporated in Gasometer B two light-finished volumes with a total of 330 apartments and student residence: an interior one independent of the pre-existing ceramic structure with radial distribution and central courtyard, and an exterior one with sinuous forms and punctual connections (Fig. 9).

Manfred Wedhorn housed in the gasometer C a volume with 92 apartments staggered and white towards the central courtyard. Finally, in gasometer D, Wilhelm Holzbauer occupied the center with a core and three housing volumes, which delimited three courtyards with the preserved brick envelope (Wehdorn, 2002, pp. 90-111; CoopHimmerb(l)au, et al. 2002, pp. 71-79).

Alliance Building at the Gasworks, Dublin, Ireland. O'Mahony Pike Architects. Housing Project, 2006

The Alliance Building is a former gas deposit, located in Dublin, Ireland, rehabilitated with a housing project carried out by O'Mahony Pike architects in 2006. It is located in the port area of the city center, an industrial site since the 1870s, which in recent years has undergone a rapid and intense process of urban regeneration with the introduction of residential, commercial and office uses.

It is the only gasometer with a cast iron lattice structure preserved in the area and considered after its cataloguing and protection an important industrial archaeological monument. The 62 m. diameter frame, manufactured in London in 1885 by S. Cutler and Sons, is made up of 24 masts joined on two levels with metal frames and braced with tie rods. Fully restored, its interior houses an independent glazed structure with 240 apartments distributed over nine floors, a circular landscaped courtyard in the center and four vertical cores around it (Figg. 0, 10). The transparency of its façade makes it a privileged observation point and its location and entity, an icon and landmark in the landscape (O'Mahony Pike, 2006).

Fig. 10. Alliance Building at the Gasworks, Dublin, Ireland. O'Mahony Pike Architects. Housing Project, 2006 (source: O'Mahony Pike 2006, p. 71).

Gasometer in Stade, Germany. Gerhard Buttge Architect. Housing Project, 2015

The project to transform a gasometer located in the harbor of the city of Stade, Germany, into a residential building by architect Gerhard Buttge in 2015 furthered the regeneration of the urban area Harschenflether Vorstadt, formally designated in 2013 with a Master Plan to develop a mixed-use neighborhood.

The 29 m. diameter gasometer, built in 1955, consists of a cast-iron framework made up of 12 lightweight pillars joined on three levels and braced with triangulations. Its rehabilitation entails the incorporation of

Fig. 11. Gasometer in Stade, Germany. Gerhard Buttge Architect. Housing Project, 2015 (source: Buttge Architects website).

this structure to a unitary base of sheet metal with parking on several levels, and its union through intermediate slabs, which contain 36 dwellings distributed over six floors with a central core and a transparent aluminum and glass façade, which provides wide views and different orientations (Fig. 11). The project, in accordance with the status of protected monument, ease of use and affordability, results in a unitary building, in which the historical framework shapes the façade, adding a new order (Buttge Architects website).

Gasometers in King's Cross, London, England. Wilkinson Eyre Architects. Housing Project, 2018

The rehabilitation of three gasometers in King's Cross, London, England, to accommodate three residential buildings with Wilkinson Eyre's 2018 project, is part of an extensive program of urban redevelopment with

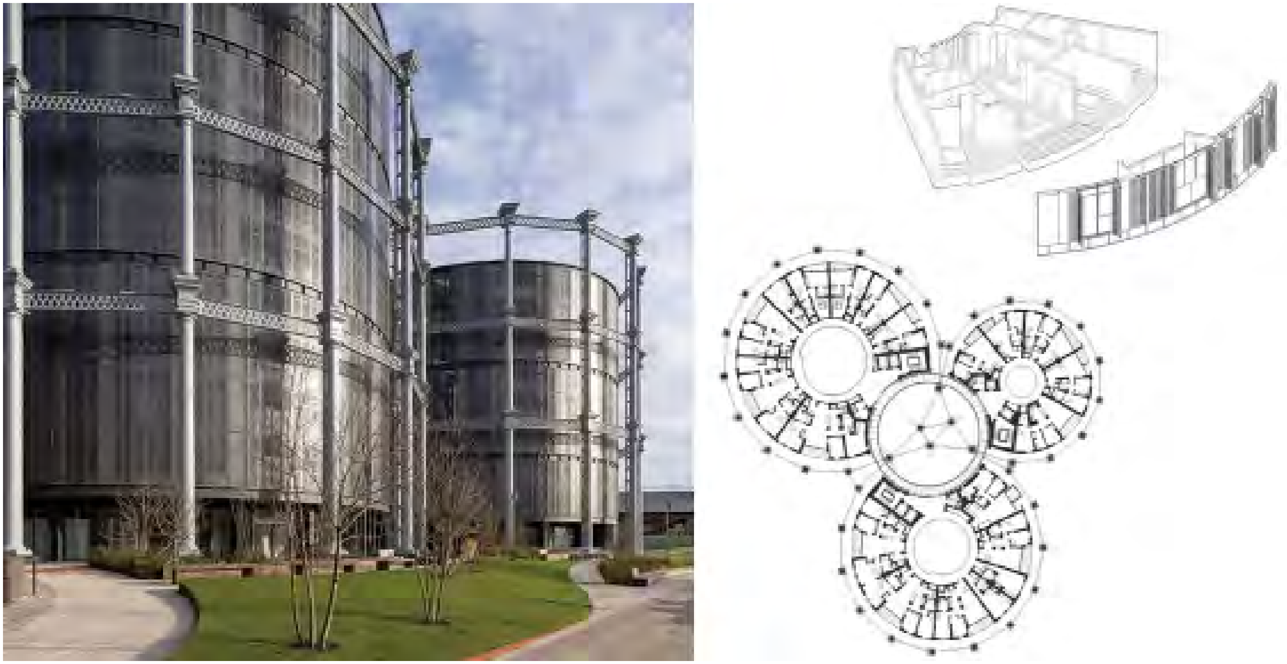

Fig. 12. Gasometers in King's Cross, London, England. Wilkinson Eyre Architects. Housing Project, 2018 (source: Wilkinson Eyre, 2018a, pp. 18-20).

preservation of industrial heritage. It consists of three cast-iron guide frames of different diameters - the largest, 45 m. - tangent to each other, built in 1867 and dismantled in 2001, which were subsequently listed for the great heritage value of their monumental columns joined on three levels. The project proposed three cylindrical housing containers separated from the cast iron trusses and of different heights, to suggest the movement of the original gasometers.

A fourth virtual drum, located in the intersection of the three structures, forms a central landscaped courtyard that concentrates the accesses (Fig. 12). The project includes 145 apartments with common facilities of gym, spa, lounges, dining rooms and bar. In each volume, access to the apartments is provided through a circular, glass-roofed central atrium, with walkways around it on each floor, where light is reflected in a water fountain. The radial configuration gives rise to diaphanous apartments, which take advantage of the natural light on the perimeter. The roofs were conceived as gardens that naturalize this re-inhabited urban landscape, and the façades as transparent planes of modular steel and glass panels protected by perforated sheet metal panels to provide shade and privacy for the occupants. All of this creates a dynamic counterpoint between the old and the new, which maintain the autonomy of heavy industrial aesthetics and the delicate refinement of new materials (Wilkinson Eyre, 2018a, 2018b, 2019).

Final Reflections

The historical industrial heritage has acquired different degrees of protection that have allowed it to be preserved, interpreted, and enhanced. In this chapter we have reviewed different strategies for the conversion of warehouses, silos, and gasometers into residential complexes. The great diversity of forms of intervention, which emphasize or conceal, preserve, or modify, link or make independent, etc. the most characteristic elements of the buildings, highlights the need to define transversal policies for safeguarding and rehabilitating these infrastructures, with universal conservation criteria.

In relation to the viability of the intervention, the regeneration of these obsolete industrial areas depends mainly on factors such as: economic considerations, which prioritize balance with the benefit to the community or the environment; urban diversity, optimizing the mix of uses; the ability to solve current problems from the indispensable historical reference; the potential to find signs of collective cultural identity, which compensate for strictly utilitarian aspects; and the richness of the urban landscape, to contribute to the complexity and cohesion of the city.

When considering the element to be preserved, in addition to the values of the building itself, it is necessary to take into account historical, cultural and educational qualities, related to the historical memory of the forms of economic activity carried out in the past, and external spatial values, linked to its urban-landscape contribution. Awareness of the physical context's importance in the process of conservation and rehabilitation of industrial heritage is a fundamental active part of the responsible management of cities in order, as indicated in the Aalborg Charter (1994, pp. 97-98), to undertake interventions in an integrated, holistic, and sustainable approach.

Hence the importance of knowing the origin and contribution of each work to architecture and the current way of life, in order to reach a global awareness that, linked to the concept of historic urban heritage, triggers a broadening of regulations capable of implementing criteria for intervention. Kevin Lynch (1960, p. 119) alluded that we need an environment, not only well organized, but also poetic and symbolic, that addresses individuals and their complex society, their aspirations and historical tradition, the natural setting and the complex movements and functions of the urban world. The city provides a basis for clustering and organizing these meanings and associations, highlighting human activity, and encouraging the formation of memory traces.

The articulation of industrial heritage with history and the city opens new lines of reflection, necessary to define its conservation principles and practices. The state of revision to which this discipline is subjected, responds to a flexible way of understanding heritage as part of a living and dynamic city, in constant need of adaptation to change, and open to new objectives with a focus more integrated and linked to the territory.

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References

Bandarin, F., & Van Oers, R. (2012). *The historic urban landscape: managing heritage in an urban century*. Chichester: Wiley-Blackwell.

Biel Ibáñez, M.P. (2016). El patrimonio industrial en el siglo XXI y su relación con la ciudad posindustrial. In A. Hernández Martínez (Ed.) *Conservando el pasado, proyectando el futuro: tendencias en la restauración monumental en el siglo XXI*, pp. 157-176. Zaragoza: Institución Fernando el Católico.

Broto, C., & Mostaedi, A. (2006). *Rehabilitación: Nuevos conceptos*. Barcelona: Structure.

Burnham, S. (2018). *Reprogramming the City: Doing more with what we have*. London: VRMNTR.

Buttge Architects website <https://www.architekt-buttge.de/projekte/gasometer> (accessed 28 April 2024).

Capel Sáez, H. (1996). La rehabilitación y el uso del patrimonio histórico industrial. In *Documents d'anàlisi geogràfica*, No. 29, pp. 19-50.

COBE (2017). Suiting the silo. In *Architectural review*, Vol. 242, No. 1444, pp. 58-65.

COBE (2019). Reconversion of a silo. In *Arquitectura viva,* No. 213, pp. 22-27.

Nouvel, J., Wehdorn, M., & Holzbauer, W. (2002). Apartment building Gasometer, Vienna. In *GA document,* No. 69, pp. 68-79.

European Cities & Towns Towards Sustainability (1994). *Charter of Aalborg*. European Conference on Sustainable Cities & Towns. Aalborg, Denmark, 27 May 1994. <http://www.sustainablecities.eu/the-aalborg-charter/> (accessed 28 May 2024).

Garcés, J., de Seta, D., Bonet, A., & Rovira, B. (2015). Viviendas no convencionales en el Passatge del Sucre. Barcelona, Spain. In *ON diseño*, No. 352, pp. 232-245.

Gudmand-Høyer, J., & Edvars, J. (1984). Jernstøberiet, bofællesskab i Himmelev ved Roskilde. In *Arkitektur DK*, Vol. 28, No. 6, pp. 234-238.

Hernández Martínez, A. (2013). El reciclaje de la arquitectura industrial. In M.P. Biel Ibáñez (Ed.). *Patrimonio industrial y la obra pública*. Conference proceedings. Zaragoza, 16-18 April 2007. Coord. Zaragoza: Gobierno de Aragón, 2007, pp. 29-52.

HRTB (2002). Residencia de estudiantes en un silo de 1953, Oslo. In *AV Monografías*, No. 98, pp. 110-113.

HRTB (2003). Student housing, Oslo. In *Architektur Wettbewerbe*, No. 195, pp. 26-29.

HRTB, & Mowe, O. (2004). Student residence, Oslo. In *Architecture interieure cree*, No. 313, pp. 54-55.

Dot Jutgla, E., & Pallares-Barbera, M. (2015). Patrimonio industrial, revitalización económica y compacidad urbana en el Poblenou-22@Barcelona ¿Un nuevo modelo Barcelona? In *Boletín de la Asociación de Geógrafos Españoles,* No. 69, pp. 9-35.

Keiding, M. (2003). Housing in the Torpedo Boat Hall (Tegnestuen Vandkunsten). In *Arkitektur DK - Nyt i gammelt [New in old]*, Vol. 47, No. 4, pp. 234-241.

Laudy, S. (2011). Conversion of a factory, Barcelona; Architect: Jordi Garcés. In *A10,* No. 38, pp. 27-29.

Lynch, K. (1960). *The image of the city*. Cambridge, MA: MIT Press.

Lindhardt Weiss, K. (2018). *The Silo - COBE. Ny Dansk Arkitektur*, Vol 2. Copenhague: Strandberg Publishing.

López Corduente, A. (2011). *22@ Barcelona: 10 anys de renovació urbana*. Barcelona: l'Ajuntament.

Martí Checa, N.A., Claver, N., Fernández Delkader, M., Fernández Valentí, R., Güell, A., Gatnau, M.J., & Llobet, X. (2000). *Poblenou i la reconversió de les fabriques*. Barcelona: Arxiu Historic del Poblenou.

MVRDV (2005). From silo to loft apartments: MVRDV's building in Copenhagen. In *Baumeister*, Vol. 102, No. 11, p. 14.

Nouvel, J. (2001). Gasometer A, Gasbehalter Simmering, Vienna. In *Arquitectura Viva*, No. 81, pp. 48-51.

O'Mahony, P. (2006). Docklands revival - a converted gas holder forms the centrepiece of a mixed-use scheme in Dublin's docks. In *Architecture today,* No. 167, p. 71.

Roldán, J.M, & Berengué, M. (2020a). 46 VPO en la nave de Fabra & Coats, Barcelona. In *AV Monografías*, No. 223/224, pp. 160-167.

Roldán, J.M, & Berengué, M. (2020b). Viviendas en la nave de Fabra & Coats. In *Arquitectura Viva*, No. 226, pp. 20-29.

Wehdorn, M. (2002). Gasometer projects, Vienna, Austria. In *A&U,* Vol. 5, No. 380, pp. 84-111.

Wilkinson E., & Tuckey, J. (2018a). Circles of life. In *Architecture today,* No. 286, pp. 14-23.

Wilkinson Eyre & Tuckey, J. (2018b). Steely can. In *Architectural record,* vol. 206, n. 4, April, p. 74.

Wilkinson E. (2019). Gasholders in London, UK. *Architectural review*, vol. 245, n. 1458, February, p. 109.

Zucconi, G. (1997). *Gustavo Giovannoni, del capitello alla città*. Milan: Jaca Book.

The Mercado del Progreso of Oviedo. Analysis and urban evolution

Marta Alonso Rodriguez, Noelia Galván Desvaux

Introduction

The city of Oviedo, capital of the Principality of Asturias, has been an important centre of trade and commerce since its beginnings. Its strategic location in the north of Spain, at a crossroads between the Cantabrian coast and the centre of the peninsula, has favoured the development of a dynamic commercial activity over the centuries. However, it was not until the 19th century that this activity was significantly boosted by industrialisation and the consequent demographic and urban growth. In this context, the construction of covered markets became an imperative need to meet the growing demand for fresh and manufactured products, while contributing to the organisation and modernisation of urban space.

Background to the covered markets in Oviedo

The first manifestations of trade in Oviedo date back to medieval times, when the city established itself as an important centre of pilgrimage to Santiago de Compostela. Small street stalls were set up around the Cathedral and the main access roads, where local products and those from other regions were sold. However, the lack of adequate infrastructures and the absence of sanitary control over food products made it difficult to develop an orderly commercial activity. Generally, these activities were located in areas where streets converged or near the convents that were distributed on the outskirts of the city. One of the places where street trading first took place was none other than the current Trascorrales square, which at least from the year 1498, became home to the butcher's and fishmonger's shop, and would certainly also be the place chosen for the purchase and sale of other products brought into the city.The current Plaza de la Escandalera was also an enclave destined for a spontaneous market, a place where the peasants would go to sell their produce, and it was the first market outside the city walls. Until then, Trascorrales and Cimadevilla were the places where most of the commercial area was concentrated, and the latter square in particular needed to be relieved of this function in order to be able to host other public events. This was solved with the construction of the Plaza del Fontán. In order to give the area a more appropriate place for the sale of goods, an arcaded square was planned. The initial construction of the Fontán arcaded square was carried out between 1792 and 1794, under the direction of the municipal architect Francisco Pruneda y Cañal. This project, approved by the Oviedo City Council on 11 June 1792, responded to the need to provide the city with a covered space for commerce, replacing the traditional open-air markets that were held in the area.

Pruneda y Cañal conceived the square as a rectangle opened by four passages, with shops and businesses on the ground floor and dwellings on the upper floors. The original design also included corner towers to enhance the presence of the complex. However, the Fontán arcaded square underwent significant modifications during the 19th century. The merchants requested that the attics of the shops be extended to be used as dwellings, which affected the original proportion of the square. Shaped like a rectangle with a ground plan of some 65 by 30 metres, it would be used to house shops and businesses on the ground floor, with the upper part for storage and towers on the corners for housing (Ruiz-Tilve Arias, 1994, p. 24). As a result, the side streets, which initially had an appropriate proportion between the width of the street and the height of the buildings, were affected by the increase in the latter. The opening of Fruela and Uría streets around 1880, ended up transferring the commercial activity to this new expansion area. The market was thus reduced to the sale of products from the rural outskirts, to which the locals went on Thursdays to stock up on foodstuffs, flowers and to stroll around surrounded by such a grand landscape.

The 19th century and the construction of covered markets

Although industrialisation in Asturias is considered to have begun with the opening of the Trubia factory at the end of the 18th century [1], this process actually took a long time, not becoming effective until the second half of the 19th century. It was from 1850 onwards, coinciding with the reopening of this arms factory, the mechanisation of the mining industry and the creation of iron and steel companies, that the industry saw a notable increase in its development and began its period of splendour. Asturias possessed two of the basic materials for the production of machinery: coal and iron. Due to the greater abundance of the former, development was centred mainly on the extraction of this mineral, including all the additions involved in its transport. The transformation that this fact meant for Asturian cities was evident, influencing not only the new areas of growth, arising from the need to accommodate the new working population that was arriving, but also affecting the historic centres which, not resigning themselves to abandoning their supremacy over other areas of the city, found their new settlers in the new industrial bourgeoisie.

Among the urban reforms carried out in the city of Oviedo during the 19th century, the demolition of the medieval fence that surrounded the oldest part of the city is worth mentioning, as can be seen from the large number of files relating to it that can be found in the archives. The main reasons for this, as can be seen in some of these files, were the poor communication that existed between the interior and exterior through the arches of the fence, due to its narrowness, and the new hygienic and health considerations, which found these areas unhealthy.

If the previous centuries were known as those of the illustrious palace constructions and private residences, this new century was the one that brought with it the great endowment constructions, with the appearance of theatres, markets, and other institutional buildings, as a complement to the improvements that were beginning to be made in the infrastructures. In addition, we should add the growth of the industrial sector in the city, with the centralisation in 1856 of the workshops of the arms factory in the grounds of the former convent of La Vega and the appearance of the tobacco factory.

Added to this, we find the densification of the capital, with an increase in population, which went from less than 10,000 inhabitants at the beginning of the century to almost 50,000 in a hundred years (Ansón Calvo, 1990, p. 36) [2]. At the same time as industrial growth was taking hold in Asturias, the railway appeared, both symbols of the city's development. On the other hand, the city experienced a more bitter side, produced to a large extent by the above, and which consisted in the demolition of a large number of emblematic and singular buildings in the city centre. To all this must be added the growth of the tertiary sector, which increased with the establishment of the city as the administrative capital, political and service centre, which led to the appearance of public bodies such as the provincial council, the provincial hospital, or the political government, developing a great deal of commercial and financial activity.

The widening of the Uría road and the spatial growth of the capital towards this new area was managed by private hands. The city council refused to present an urban planning plan for the widening sector for economic reasons, and so streets were opened at the request of neighbours, motivated by private interests (Tomé, 1988, pp. 71-73). The scarcity of economic resources was the perfect excuse for not providing the city with a widening plan, although the new street was almost a kilometre long and, with its 16-metre width, it was an easily amortisable place. The new city grew parallel to the old one, providing the population with new facilities, such as the Fontán and Progreso markets, the Banco Asturiano, the General Hospital, the new Model Prison on the slopes of Naranco, the Seminary and the Cemetery. In 1845, the walls of the Convent of Santa Clara were demolished and the land occupied by its gardens was made available to the city, which also allowed rapid building growth in this area, on the site of which the city's theatre, the Campoamor, was built between

Fig. 1. Plan of the surroundings of the Marcado del Progreso building (yellow), circa 1900 (drawing: authors).

1883 and 1892 by J. López Salaberry and Siro Borrajo Montenegro [3] and the new covered market designed by J.M. de la Guardia, popularly known as the Placina, at the confluence of Calle Pelayo and Paseo de Santa Clara (Fig. 1).

This expansion was the place chosen not only by the wealthy classes but was soon to be occupied by the commercial sector and also by several congregations, who opted to open their convents in the vicinity, such as the Salesas, the Siervas de Jesús de la Caridad or the congregation of

Fig. 2. Plan drawn up by Joaquín maría Fernández and the modern part added by Javier Aguirre (drawing: AMO).

the Esclavas in calle Toreno. The Church of San Juan el Real, located in Calle Doctor Casal, in the Estancos neighbourhood, was built between 1902 and 1909, at a time when the new buildings of the bourgeoisie were still coexisting with the small pre-industrial buildings that had been installed beforehand. It was built as the new parish church of the Uría district with the pretensions of a large and magnificent temple for the new bourgeoisie.

It can be seen in the 1885 plan of the city (Fig. 2), how most of the proposed infrastructures were centred in this area of connection between the old and the new city, around the park of San Francisco, which acted as a place for recreation and strolling for the new bourgeoisie after its disentailment. Thus we find adjacent to this area the project for the new Campoamor theatre (1892) and the merado del Progreso (1887), both built on the grounds of the former convent of the Poor Clares, the Don Santos passageway (1892), which joined the streets of Uría and Pelayo and was occupied by various shops, the palace of the Provincial Council (1910) or the project that was never built to cover Calle Principado with an iron and glass roof.

In addition to all the buildings corresponding to institutions, new powers and services that were built, including markets, barracks, hotels, courthouses, and theatres, we must add the reforms that were carried out in the streets of the city with the arrival of electricity and lighting, which incorporated elements such as streetlamps and the electric tram into the street furniture.

During the 19th century, Oviedo experienced significant economic and social growth, which was reflected in the vitality of its markets. These commercial spaces were not only centres for the exchange of products, but also meeting and socialising places for the population. Although the location of the railway stations was a determining factor in the growth of the city of Oviedo, so was the location proposed for the markets that began to appear in the city, in response to the need to create covered spaces to replace the old open-air markets.

In some cases, such as the 19 de Octubre market, the location responds to an internal restructuring of the city, seeking to improve both the place where it is located, the Plaza del Fontán, and its immediate surroundings, with the idea of giving a new life to this somewhat forgotten sector of the old city (Molina & Morillón, 1994, p. 48). The same is true of the market planned for Trascorrales, whose construction provides a roof and better sanitary conditions for a practice that had been taking place in these areas for a long time (Fig. 3).

Around 1882, the construction of two markets in the city of Oviedo was proposed, and the places chosen were the Plaza del 19 de Octubre (next to the town hall square) and the space occupied by the former market gardens of the convent of Santa Clara, which had already been

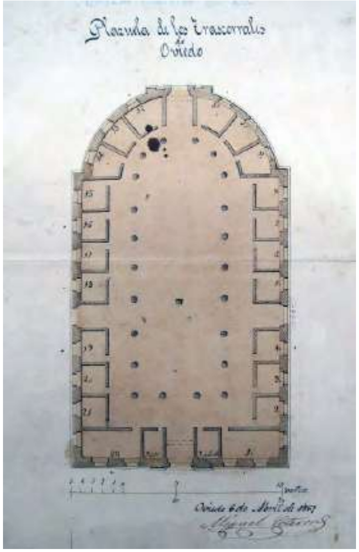


Fig. 3. Plan of the Trascorrales market, 1862 (image: AMO).

Fig.4. Plan of the streets of Uría and Fruela, made by the engineer Don Salustiano Regueral, at the start of the construction project in 1868 (image: AMO).

disentailed. Both spaces were strategically located close to Calle Uría, a new artery of the city that connected the historic centre with the train station (Fig. 4).
The city's most emblematic market was the first of those mentioned. Its origins date back to the Middle Ages, but it was in the 19th century that it experienced its greatest boom. The current market building, in the Art Nouveau style, was built between 1882 and 1885 (Fig. 5). This building, designed by Javier Aguirre in wrought iron, is still standing today and is a notable example of nineteenth-century architecture in Oviedo.

The mercado del Progreso

The mercado del Progreso known among the people of Oviedo as la placina was located on the site of the Santa Clara vegetable gardens, next to the Campoamor theatre, on the block where the Jirafa building, and post office are today. Until the disentailment in 1845, this place was usually used for markets and was known as Campo de la Lana and was enclosed by the convent wall. The project, by J. Aguirre, was drawn up in

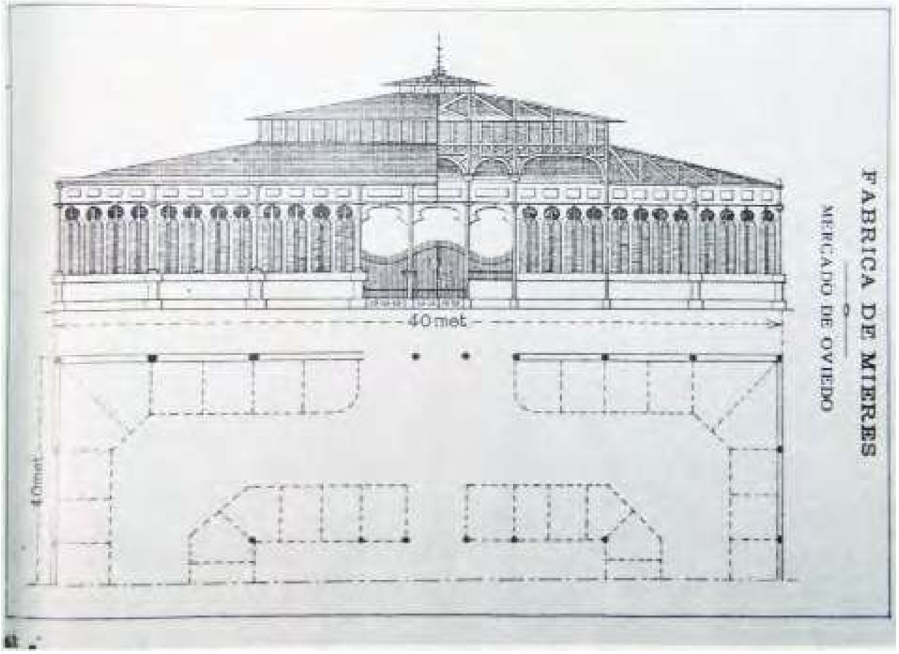


Fig. 5. Plan, façade and section of the 19 de Octubre market, 1907 (drawing: Fábrica de Mieres product catalogue).

1882, although the one that was finally carried out corresponds to J.M. de la Guardia. Its exact date is unknown, the work being completed around 1887 (Molina & Morillón, 1994, pp. 118-120). Formed by two naves arranged in a T-shape, it occupies a triangular site, one of the arms being the largest, which was also the one that gave access to the building from its ends. A third door was located in the centre of the long nave. As for the façade, it was built on a stone plinth made of iron and glass (Fig. 6).

J. Aguirre's initial project was not finally carried out, although the reasons for this are unknown, and the main difference with the one that was finally built was in its layout, as Aguirre proposed the total occupation of the triangular site, whereas the one that was finally built would have been T-shaped.

The mercado del Progreso had a metal structure made in the Mieres factory and a tile roof. It had two main halls and several smaller stalls. The

Fig. 6. Image of the interior of the market. Archivo de Rodríguez Curieses (https://www.facebook.com/650302524990009/photos/a.650313011655627/976368712383387/?type=3.)

main façade, facing Pelayo Street, was decorated with horseshoe arches and ceramic elements. The Mercado del Progreso was a representative example of Asturian neo-Mudejar architecture, characterised by the use of local materials, such as limestone, and by the incorporation of decorative elements typical of the region, such as noble coats of arms.

The neo-Mudejar style of the Mercado del Progreso was not only an aesthetic element, but also reflected the interest in Spanish history and culture that existed at the time (Fig. 7). Moreover, this style contributed to creating an identity of its own for the city of Oviedo. The structure of the market was made of metal, but this was integrated into the design of the building through the use of decorative metal elements, such as railings and balustrades. Colourful tiles with geometric or floral motifs were used to decorate the façade, friezes and pillars. Its metal structure, innovative for the time, was harmoniously integrated into the design of the building, combining functionality with aesthetics. It was a lattice structure, made up of wrought iron beams and pillars. This type of structure was very strong and made it possible to create large, open spaces, ideal for a market. The

Fig. 7. Oviedo. Pelayo Street and marcado del Progreso, 1933. Museum of the Asturian People. Collection: Celso Gómez Argüelles (Author: Gómez Argüelles, Celso. (https://fondos.gijon.es/fotoweb/archives/5021-Fondos-fotogr%C3%A1ficos/MPAFondos%20fotogr%C3%A1ficos/G%C3%B3mez%20Arg%C3%BCelles%2C%20Celso/CGA-341%20FF045220.tif.info).

metal elements were combined with other materials, such as brick and stone, creating an effect of contrast and visual richness. The long hall was 66 metres long and faced Pelayo Street, while the short hall, forming the shape of a T, was 22 metres long. Both were 14 metres wide (Fig. 8). The design included three doors: two on each side of the long nave and one in the centre. Since the terrain was not completely flat, the alignment of the Campoamor theatre was maintained and the differences in level were solved with steps (Fig. 9).

However, like many other structures in the city, it suffered the ravages

Fig. 8. View of the Progreso market in Pelayo Street, ca. 1930 (https://twitter.com/Histoviedo/status/1324287981616771074/photo/2Iron, from the Fábrica de Mieres, was the main material used, together with glass, complemented by a plinth of exposed brick and stonework).

of war and never again recovered its original function as a market. For a period, the space was dedicated to sporting activities, being used as a bowling alley in El Progreso and for basketball in Santa Clara. Unfortunately, the Mercado del Progreso was demolished between 1950 and 1953. The bus station was located on the block of the old mercado del Progreso, close to Calle de Uría, which facilitated communication with the city centre. Later (Molina & Morillón, 1994, p.118), it was replaced by the building that would soon be known as 'La Jirafa'.
The causes of its demolition were diverse, including the deterioration of

Fig. 9. View of San Francisco Park, Escandalera and Pelayo, in 1920. In the front, the building known as Casa del Conde In the background on the right, the old progress market in Pelayo Street (picture: RIDEA-Royal Institute of Asturian Studies).

Fig. 10. Virtual reconstruction of the mercado del Progreso building. Image of the current Jirafa building that was built on the site (editing: authors).

the building and the urban planning of the time. The construction of the La Jirafa building was completed in 1957 (Fig. 10). The original project, designed by architects Gabriel de la Torriente, Fernando Cabanilles and Joaquín Suárez Pérez-Fonseca, envisaged a multi-purpose conference centre with a hotel, offices, post office, post office and shops. However, the building was finally used for offices and commercial premises (Nanclare & Ruiz, 2014).

Conclusions

The mercado del Progreso, located in the heart of the new Oviedo, next to the Campoamor theatre, played an important social role as a place for strolling, revitalising the surrounding commerce that was promoted as being close to El Progreso. Despite its initial success, the market experienced a gradual decline throughout the 20th century. The emergence of new supermarkets and shopping centres on the periphery of the city, together with changes in consumer habits, eroded the importance of the traditional market.

The disappearance of this market was an irreparable loss to the architectural and historical heritage of the city. Its demolition represented the end of an era and a break with a space that had been a witness and protagonist of Oviedo's urban and social evolution for more than half a century.

Notes

[1] In 1794 it was decided to move the arms factory, which until then had been located in Navarre, to Asturias, due to the attacks it had received from the French revolutionaries, in an attempt to move it away from the border of the French Pyrenees, locating it in a very closed valley that was easy to defend. http://es.wikipedia.org/wiki/F%C3%A1brica_de_armas_de_Trubia.

[2] According to the 1787 census, the population of Oviedo had 6257 inhabitants on that date. Floridablanca Census (Carlos III).

[3] Municipal Archive Inventory Catalogue. Urban Police. AMO Files organised by streets 2334-2434. Campoamor Theatre.

References

Ansón Calvo, M. C. (1990). *La ciudad de Oviedo en el siglo XVIII: Estudio informático*. Oviedo, España: Fundación de Cultura, Ayuntamiento de Oviedo.

Molina, F. J. R., & Morillón, G. J. (1994). *La arquitectura del hierro en Asturias. 13 mercados y otros edificios urbanos*. Oviedo, España: Colegio Oficial de Arquitectos de Asturias.

Nanclares, F., & Ruiz, N. (2014). *Lo moderno de nuevo: Arquitectura en Asturias, 1950-1965*. Oviedo: LaMicro.

Ruiz-Tilve Arias, C. (1994). *El Fontán: Guía para nostálgicos*. Oviedo: Ediciones KRK.

Tomé Fernández, S. (1988). *Oviedo: La formación de la ciudad burguesa (1850-1950)*. Colegio Oficial de Arquitectos de Asturias.

“La fabrica” or how to inhabit a ruin.
Riccardo Bofill’s pioneer experience with Industrial Heritage

Raquel Álvarez Arce, Sara Peña Fernández

Introduction

In the 1960s, an international and multidisciplinary team called *Taller de Arquitectura* (Architecture Workshop) was created in Barcelona around the figure of Ricardo Bofill. The team was formed by the set designer and architect of Uzbek origin Manuel Núñez Yanowski, the English architect Peter Hodkingson, the writers Jose Agustín Goytisolo and Salvador Clotas, and the Italian actress Serena Vergano, among others. The team focused its work during the 1960s on the geometric generation of collective housing and community living.

In 1970, after a failed attempt to build his proposed spatial city in Madrid, Ricardo Bofill looks for a place in the metropolitan area of Barcelona where to build the city in the space of *Taller de Arquitectura*. In his search he finds a space on the outskirts of Sant Just Desvern, where the cement factory known as “*La Sansón*” was being dismantled. Bofill describes the encounter with the place as an inspiring moment:

“Instead of being Madrid it was Barcelona, we made it weigh, and instead of being so crazy we said: we will define the project, we will define it ourselves and we will do it. I went to look for land. I lived in Barcelona, I took the car and I said: well, I’ll look in the countryside because Barcelona is a closed place and you cannot do any experience. I get here and then they were destroying this factory. I go to talk to the doorman, I remember him very well, and I say “Will you let me in? and he says NO! Come on, let me in, how about a tip? The universe was fantastic, I remembered the most childish things, the factories, the grottoes, the tunnels, all this. And in the afternoon, I’m going

Fig. 1. Photograph of the Sanson Factory in 1921. Source: Arxiu Històric de l'Ajuntament de Sant Just Desvern [AHSJD], Colleccions. Fàbrica de Ciment La Auxiliar de la construcción SA, Sansón 1920-1968 (photo: Caja 8/Albúm Sr. Vila Casas, 1921).

to sign with "La Sanson" for 108 million bucks, and I didn't have a penny; besides they just gave me a lawsuit, I paid one million bucks, and 107 in letters." [1].
Thus began the project, on the land occupied by the old cement factory, taking up the formalization of this *city in space*. And it would be name as Walden 7 in honor of the homonymous science fiction book by Skinner [2]. A utopian work, as it would be, that in order to be carried out needed the financing of the *Banco Industrial de Cataluña* (BIC), through the mediation of Jordi Pujol from the Banca Catalana.

The sansòn
The demolition that Bofill finds are the remains of a factory of the company *La Auxiliar de la Comunicación* (LACSA), a corporate founded in January 1917 that already owned other facilities in the area. The plant started operations on June 12, 1920 as a support factory for some of the company's other factories (Fig. 1). And so, the new facility will produce artificial Portland cement under the name *Sansón*. The layout of the new

Fig. 2. Areal view of the factory in the 1960s. Source: Cartoteca del Instituto Cartográfico de Cataluña (http://patrimoniminerdecatalunya.blogspot.com/2014/06/fabrica-de-ciment-de-sant-just.html).

plant was devised by its director, Joaquim Molins, after traveling around Europe and the United States visiting buildings and industrial complexes from which to learn new production processes. Thanks to this previous study, the cement plant, compared to the artisanal processes of the time, stood out because of its automation and modernity.

A few years later, in 1924, an important reform was carried out inside the factory, the construction of a large chimney 102 meters high that still marks the profile of the town of Sant Just Desvern. The project increased cement production to 110.,000 tons of cement per year. In the 1945 aerial photos, we can see how the *Sanson* was located in a rural setting, far from the urban center of Sant Just Desvern, and surrounded by fields of crops. However, the photographs already show the outlines of the future arteries that currently organize the area (Fig. 2).

During the Spanish Civil War, *Sansón* was considered a war industry,

in order to guarantee the production of cement needed for defensive buildings. Surprisingly, the factory was not bombed, so the modern facilities quickly resumed production after the conflict.
The increase in production, which coincided with the country's years of economic expansion, required extensions to the plant (Fig. 3). In 1950 a refrigerator was built, and in 1951 an underground water line, a new kiln for the production of natural cement and a thermal power plant for the production of energy [3]. In addition, during this period, in 1949 and 1955, the LACSA company built a small settlement with some housing for its workers [4], closer to the factory than the urban core.
This growth in production, which coincided with the years of economic expansion in the country, was going to generate waste and pollution with the consequent inconvenience among the local population, which caused neighborhood protests that were consolidated day by day. On April 6, 1964, the plenary session of the Sant Just Desvern council, taking note of the protests, decided to classify the activity of the cement plant as "annoying, unhealthy and harmful" (Solé & Amigó, 1988, p. 54) putting the factory's future in doubt. In 1965, when the construction assistant proposed to the city council to expand the facilities and the production of the *Sansón*, the city council did not authorize the works [5], forcing the cement company to consider closing it and moving it to the neighboring town of Sant Feliu.
In view of this situation, the head of the cement plant, Mr. Calderón, suggested to the city council the possibility of reclassifying the land from industrial to residential use. The mayor, Josep Lluis Surroca, resolves to agree to the change (Solé & Amigó, 1998), although the facility continued to operate until 1967. From that date, LACSA will progressively abandon the *Sansón* facilities in favor of the Sant Feliu plant, until the definitive sale of the land to Ricardo Bofill.

What to do with the ruin

The cement company's facilities occupied practically all the land that Bofill had acquired with his partner [6]. For this reason, on January 22,

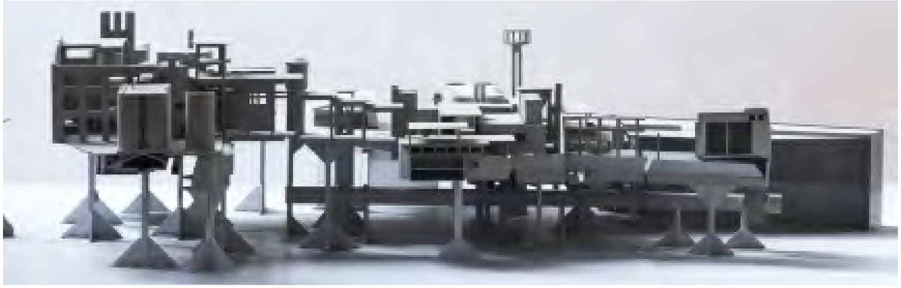


Fig. 3. Photograph of the model of the cement plant made by Taller de Arquitectura to show the elements of the cement plant that they wanted to preserve as a sculptural ruin (photo: Ricardo Bofill Archive).

1971, a request for permission to carry out a complex task of cleaning and architectural suture would be presented to the Sant Just Desvern city council:

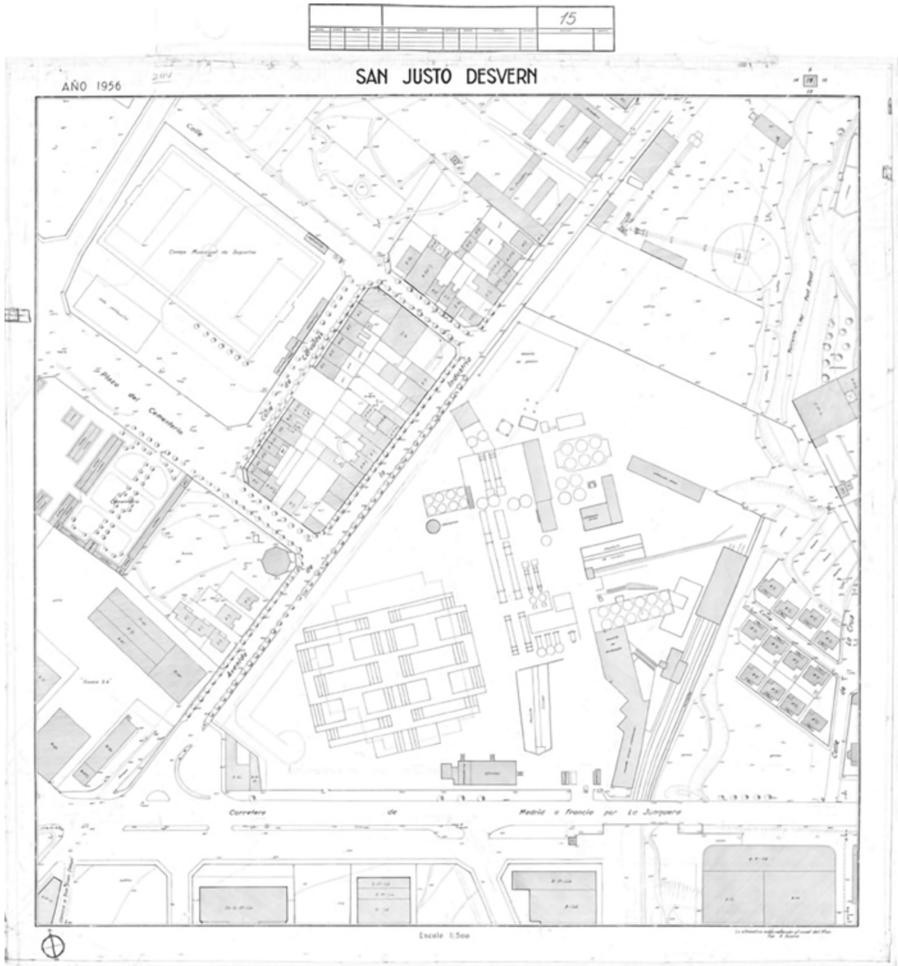
"License to carry out some work to prepare the land for the future construction, as well as the demolition of the old existing constructions of the cement factory and remodeling, cleaning and treatment as sculptural work of the singular elements, especially the silos, chimney etc... that will be used as part of the common services of the later new buildings." [7].

The work, as Joan Malagarriga tells us, began with an attempt at a graphic survey of the factory, both of the industrial part and of the offices and workers' housing (Ibid, p.40). This documentation was either never produced or has disappeared, since in the application registered on February 1, 1971 at the city council of Sant Just Desvern, for the levelling and preparation of the land, no plan appears:

"The complexity of representation in plans the demolition, discourages its presentation accompanying this letter, however, a scale model of the singular elements that will compose the sculpture is available to the technical services." ([AHSJD], Obres i urbanisme (1875-1994) Box 694).

The sculpture cited in the application referred to the set of elements that the architects intended to preserve from the old cement plant. Photographs of the model and this one are preserved in the Bofill archive, and although the city council document explains that it is a scale model of the elements that will make up the project, the three-dimensional prototype shows considerably more pieces than would

Fig. 4. Plan made by the topographer hired by the city council of Sant Just Desvern in 1956. Source: [AHSJD] (drawing: Colleccions. Fàbrica de Ciment La Auxiliar de la construcción SA, Sansón 1920-1968).



eventually be preserved. Although the planimetry was not delivered to the city council, its archive contains a series of topographic plans made in 1956, commissioned by the city council itself, in which the *Sansón* appears [8]. These plans are very relevant because, as opposed to the aerial photos in which the factory is reduced to roofs, the surveyor's survey shows the silos, pipelines, and warehouses with which the studio will work. The plan also shows an initial version of the Walden 7 building on the site, probably the result of the recycling of plans (Fig. 4).

The project process of Walden Island, understood as the different buildings that will coexist on the site of the old cement plant, will be subject to the different vicissitudes through which the work will pass. And perhaps, the proposed use for the ruins of the industry will be the one that will vary the most during the development of the industry.

In the project delivered in 1971 to the city council, the area occupied by the remains of the factory that the *Taller* wants to preserve is marked with a plot in which the legend indicates that *"The exterior surface of the elements of the duly remodeled old cement factory will be used as a green area"* [9]. This agrees with what Ramón Collado also narrates: *"The garden that was created in the center, with the vegetation invading everything, changed a landscape of gray cement dust dunes for dunes of green, transforming an industrial, suburban, aggressive landscape into a pleasant landscape, a romantic garden."* (Solé & Amigó 1998, p. 36).

In the approved project that the *Taller* delivered to the city council in August 1972, the remains of the cement plant became buildings for public use by the tenants of Walden Island. In the detailed plans [10] of the old production spaces, communal areas are proposed, occupying the decks with swimming pools. The *Taller* proposes "*a program to reuse the factory as a nerve center, center of interest and play center, a bit like the brain of Walden*" (Solé & Amigo, 1998, p.41). This focus of activity, which housed nightclubs, cinemas, and even spaces for fashion catwalks (Ibidem), also had to house experimental laboratories dedicated to the social study of the individual [11]. This idea of community center is clearly shown in a color axonometry, close to *pop art*, in which the remains of the *Sansón* appear labeled with signs that already denote these new uses (Fig. 5). No planimetries of the communal center are preserved beyond this image, but thanks to this axonometric perspective, we can clearly understand the architects' work strategy in terms of preserving the existing elements, such as the different sets of silos or the hoppers.

Despite the fact that in May 1974 the execution project was delivered

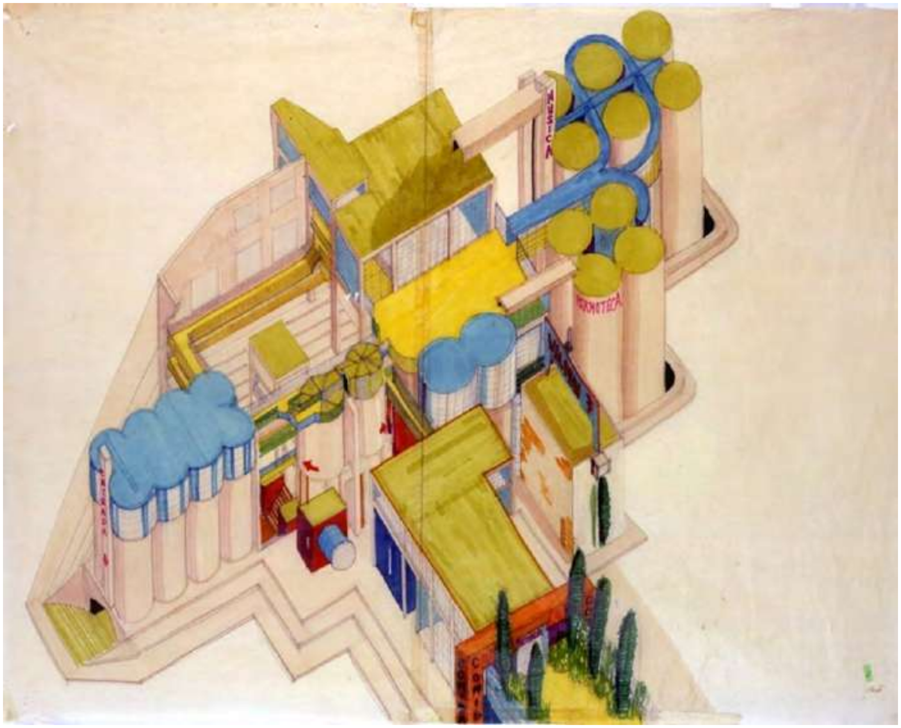


Fig. 5. Sketch showing the remains of the cemetery converted into a community center for the Walden (drawing: Ricardo Bofill Archive).

to start the second phase, it was never carried out. The reasons for the failure of this initiative were weighted between purely economic issues and those of a social nature, motivated by the complaints of the residents of Sant Just Desvern, who looked with antipathy at the construction of the rest of the project.

Thus, when the BIC (Banca Industrial Catalana) finally signed the promotion agreement with the *Taller*, the construction of the Walden Tower began (Solé & Amigo, 1998), and it is here when the fate of the Sansón's remains changes and becomes, in a certain way, governed by economic issues. Nuñez Yanowski reports that when the bank joined the development, the ruins of the cement plant ceased to be a social space for the Walden neighbours [12]. We can understand that Ricardo Bofill's will to conserve the remains of the cement factory, which are part of the payment of the fees of the *Taller* [13], transforming the *Sansón* finally into *La Fábrica*, the architect's house-studio.

The transformation in la fàbrica

The work to convert the old cement plant into Ricardo Bofill's house-studio was carried out in three stages: cleaning, delimitation and redefinition. The beginning of this transformation, probably in parallel to the change of use of the remains of the cement plant, was carried out, according to Malagarriga, as part of the remodeling of the factory (Solé & Amigo 1998). As it appears in the city council registry, the *Taller* requested to begin consolidation work on the remains, while the municipal permit was being obtained to begin work on Walden 7:

"It is advisable, until the referred municipal permit is obtained, to carry out some work that allows the preparation of the land for the future construction, as well as the demolition of the old existing constructions of the cement factory and remodeling, cleaning, and treatment as sculptural work of the singular elements, especially silos, chimney, etc., that will be used as part of the common services of the later new buildings." ([AHSJD, Obres i urbanisme (1875-1994) Leg.288 doc. 71.1972)

This first phase was carried out, according to Bofill, with "*dinamite and drilling machines*", cleaning and trying to "*reveal hidden forms and revalue certain spaces*" (D'Huart, 1984, p.81), a job for the architect comparable to that of a sculptor. During this part of the process, the *Taller* makes use of black and white photographs of the remains of the factory on which, with colored markers, they mark the elements to be removed. An operation carried out almost as a game [14], where the members of the *Taller* worked with the remains of the cement plant as if it were a large model from which to cut out and reveal elements (Fig. 6).

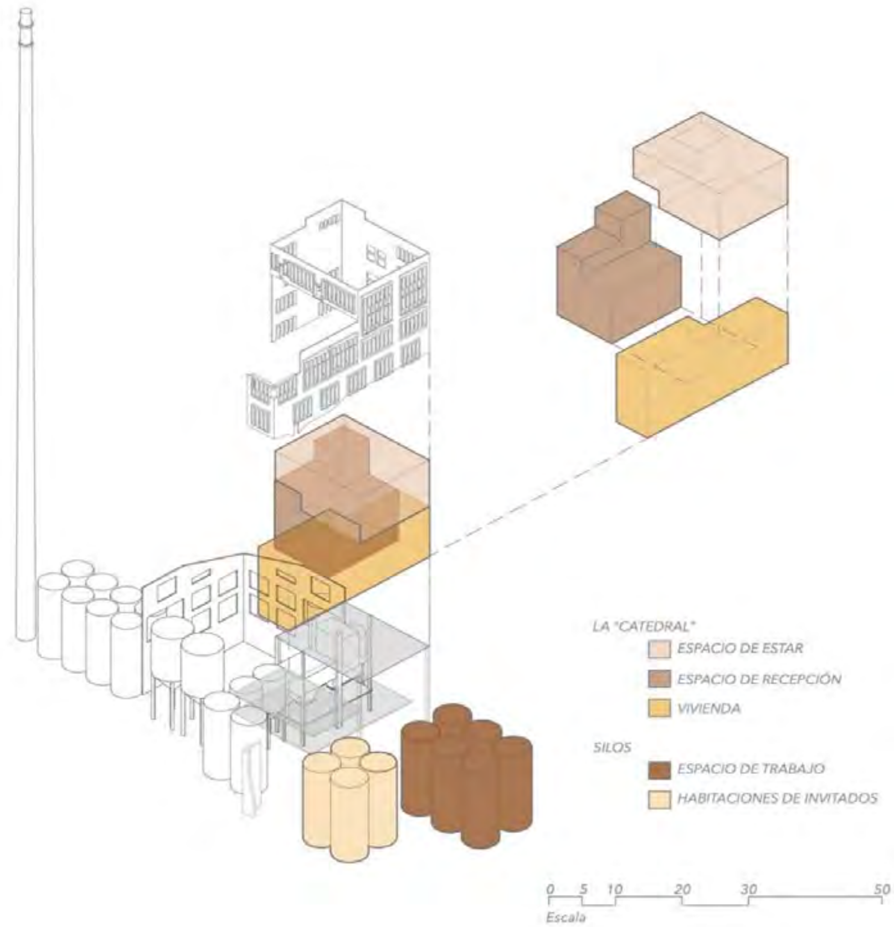
After this first surgery process, everything indicates that *La Fábrica* project becomes a personal work of Bofill [15], who will begin to work with the forms hidden in the *Sansón*. These elements that emerged after the cleaning corresponded to the different silos, elevated tanks and hoppers of the cement plant, as well as a series of large frames with their

Fig. 6. Photographs on which Taller de Arquitectura planned the transformations of La Fábrica with colored markers (image: Ricardo Bofill Archive).

floor slabs and a large perforated wall with different rectangular section openings. Spaces that make Bofill feel, in his own words, overwhelmed by the experience of discovering this industrial space. Spaces that inspired both Le Corbusier and futurist architects such as Sant'Elia, whose proposals sought the forms of large North American industrial buildings. The aesthetic references were present and at hand, Bofill only had to take them and turn them into what was to become his workshop home. After the cleanup, the remains of the cement factory emerged from the rubble and Bofill had to face the transformation of the old factory into a new architecture, an issue that he approached in very different ways depending on the nature of the remains. The hoppers and some elements such as metal turrets will be maintained as sculptural forms, incorporated in one way or another into the project. The silos, which are grouped in sets of 6, 4 and 2 elements, will house different functions depending on their relationship with what we could call the main volume. Bofill called this volume, defined by the large frames that supported the nave, *The Cathedral*, the space that would eventually house the architect's residence. The mechanism used by Bofill to assign new functions to the spaces of the cement plant has to do with the dimensions and characteristics of the pre-existing elements, causing spatial changes that make it possible to adapt the spaces to the new functional needs proposed. Bofill names each area according to its own aesthetic characteristics that derive from the dreamlike universe he seeks to create -*The Cathedral, the Garden of Delights, the Silos of Knowledge or the Catacombs*- and that would be translated into a *specific vocabulary* [16] able to articulate the new architecture. In this way, the *Silos of Knowledge*, the set of 6 of the 10 silos that were preserved from the old industrial plant, form the *Taller de Arquitectura* studio; *The Cathedral*, becomes Bofill's residence, *the Catacombs* were used for archiving, and the remaining four silos were used as guest apartments (Fig. 7).

After the first cleaning and cutting process, the *coller* phase continues, gluing and suturing where needed. This mechanism seems to respond to another project strategy, that of wrapping the remains of the cement factory in order to delimit the entire complex of *La Fábrica,* understanding, as Norberg Schulz states, that by establishing this limit the new architecture takes presence (Schulz, 1998). Thus, the architect placed a new facade that delimits the perimeter of the large frames of the industry, in which we find the characteristic set of arches that will give a new image to the whole, and that will influence the new spatiality of the complex.
Through an almost continuous envelope, Bofill encloses the space of *The Cathedral*, leaving out the elements that can work autonomously, such as the silos. We could say that, like Kahn and Venturi, he makes "ruins that envelop buildings", understanding this as a use of architectural elements behind or within others (Rodell, 2008). Ricardo Bofill wraps one ruin with another by means of the wall perforated by windows outlined with semicircular arches, but does not seek to generate a façade [17], but to delimit a space. This decision seems to be related to the symbolism

Fig. 7. Exploited axonometry of La Fábrica. On the first level, the pre-existences preserved by the Taller. The second level defines the spaces formed by delimiting the ruin and the last level defines the envelope that articulates the complex (drawing: authors).



present in the architecture of the 1970s, and to the ironic incorporation of historicist elements that had been abandoned by modernity. Bofill seems to take this path, echoing the surreal character that, according to him, he finds in the factory on his first visit [18]. The arches together

Fig. 8. Photograph showing the process of opening the windows in the cement silos, as well as the construction of the envelope (photo: Ricardo Bofill Archive).

with the industrial elements, the stairs that lead nowhere and the large chimney are reminiscent of the metaphysical paintings of Giorgio de Chirico. The disproportion of the arches brings the image of *La Fábrica* even closer to the paintings of the Italian artist's metaphysical period, where the industrial architecture, represented by the chimneys in the background, contrasts with facades of what could be an urban street with an arcaded gallery with arches. One of the challenges of this reconversion will be the transformation of the silos, which are made up of cylinders with a diameter of nearly 5 meters and built in pure concrete. Both the warehouses dedicated to the *Taller* and the guest rooms have the same modifications and readjustments. The first is the union of these by a central space that links them and allows access to the different rooms. The second, its division in height, creating different floors which are accessed from one of the cylinders, inside which a helical staircase is developed, delimited in its interior by the same arches that envelop *The Cathedral*.

Fig. 9. Ricardo Bofill walking among the remains of the cement factory (photo from Ricardo Bofill Archive).

But in order to be able to inhabit these spaces, it will be necessary to continue this process of "deconstruction", demolishing in order to build. In the style of Matta Clark, the *Taller* produces cuts and openings in the silos, to open windows that are highlighted with elements typical of the Gothic Quarter of Barcelona (Fig. 8), in what seems to be an ironic play by Bofill in incorporating historical elements in this factory space.

Tanks and silos are left clean, untreated, showing the reinforced concrete with which they were erected. The interior surfaces allow us to appreciate the original materiality of the cement factory, showing the different concrete layers, like a sedimentary rock whose texture responds to the old wooden formwork.

The surfaces of the new spaces also take up the precepts of the whole, maintaining its archaic character and delving into the sensual materiality that evokes the ruin. The interior face of the enclosures reveals the brick that makes it up, uncovered, showing the way in which the slender arch of windows is traced on the wall, almost as if in homage to Louis Kahn when he rhetorically asked the brick what it wanted to be. With this set of finishes, it seems that Bofill also wanted to tell us, not only the story of the construction of *La Fábrica*, but also its transformation, only possible thanks to the work of the catalan craftsmen. (D’Huart, 1984).

A pioneering attitude

The transformation of the *Sansón* cement factory into *La Fábrica* is a pioneering project in the recovery and reconversion of an industrial building, especially at a time when these were not considered spaces to be rethought, since most of the industries were operating at full capacity. We can only refer to the photographic series that, in the 1960s, Bernd and Hilla Becher took, establishing what today is known as industrial landscape photography and calling attention to the heritage of the facilities present in Germany at the time.

Bofill’s intervention, parallel to that of the Germans, represents a before and after in the national panorama in terms of the recovery of factory complexes of little heritage value, revaluing a piece that could not have been preserved from the architectural point of view (Solé & Amigo, 1998). The project, far from any idea related to heritage conservation, plays with a series of pre-existing elements and seeks a balanced association between the previous, the new and the expanded, placing the remains of the cement plant in a contemporary discourse, whose common thread is the use of existing structures with no apparent value. If we add to this the use for which it was intended, that of a house-workshop, the building will be the first work in which the task of establishing human habitation in a factory space is radically addressed. A difficult design challenge that sought domesticity between hoppers and silos.

Notes

[1] Ricardo Bofill in Solé & Amigó, 1998 p. 17. Translation by the authors.

[2] In Skinner's book, the protagonist visits Walden 2 on an assignment to investigate this new community that lived outside the American society of the time. At one point in the story, visitors appear from Walden 6, the last community that was beginning to be created after the third, fourth and fifth experiences. The name of the Taller de Arquitectura building, therefore, is a clear reference to Skinner's book and its communal society, alien to the country in which it is located.

[3] Arxiu Històric of l'Ajuntament de Sant Just Desvern [AHSJD], Obres i urbanisme (1875-1994), Leg.77, doc. 32, 1949; Leg 78, doc. 34, 1950; Leg. 79, doc.67, 1951; Leg. 80, doc. 82-1, 195.

[4] [AHSJD], Obres i urbanisme (1875-1994), Leg. 77, doc.53, 1949; Leg.83, doc 3, 1955.

[5] In the historical archive of Sant Just Desvern, the record of the non-authorization to build a new concrete power plant is preserved. ([AHSJD], Obres i urbanisme (1875-1994) Leg. 107, doc. s/n, 1962. "Obres no autoritzades").

[6] To purchase the land and carry out the housing development, Ricardo Bofill partners with Carlos Ruiz de la Prada.

[7] Document found in the Historical Archive of Sant Just Desvern. Due to the volume of the project, the documents related to the demolition of the site are archived separately.

[8] Curiously, the plan preserved in the archive has undergone modifications, showing in the 1956 plan one of the first proposals of Walden, surely the result of a process of reuse of plans.

[9] [AHSJD], Obres i urbanisme (1875-1994) Box 694.

[10] [AHSJD], Obres i urbanisme (1875-1994) Box 691.

[11] Comment by Manuel Nuñez Yanowski in an interview conducted by the authors on January 19, 2021.

[12] Comment by Manuel Nuñez Yanowski in an interview conducted by the authors on January 19, 2021.

[13] "Part of the Taller's professional fees were paid for with pieces of the old factory. Thus, the current Taller de Arquitectura was started after Walden." (Malagarriga in Solé & Amigó 1998, p.40) Translation by the authors.

[14] "Va a ser un treball molt interessant, encara que no sabias gaire el que feies ni perqué ho feie "; "It's going to be a very interesting job, although you didn't know much

about what you were doing or how you were doing it” (Malagarriga in Solé & Amigo, 1998, p.41) Translation by the authors.

[15] This is the opinion of Dr. Antonio Millán Gómez, Professor of Architectural Representation at the School of Architecture of the Polytechnic University of Catalonia, in a brief interview conducted by the authors with the architect about La Fábrica project. This theory is also confirmed by Manuel Nuñez Yanowski, when in the interview conducted by the authors on January 19, 2021, he confirms that this was a more personal project by Bofill, with the collaboration of the young architect Joan Malagarriaga.

[16] “Later, we had to mark the new constructions with a specific vocabulary, integrating the “vocabularies” of the history of architecture, a cultural vocabulary opposed to that of vernacular architecture.” (Bofill in D’Huart 1982, p.81).

[17] “I wanted the vegetation to eat the building and cover it. I didn’t like to do a facade here. Not for me. If you walk around here you won’t see any of this building, it’s covered by the gardens, and it’s covered by the gardens for two reasons. First because, from these windows here, I didn’t want to see anything going on outside, I want a round world. And it’s also covered because I wanted this building not to have a composite façade.” (Bofill in VVAA 2016 p.73).

[18] “SURREALISM: Paradox of the stairs that lead nowhere. Absurdity of certain elements hanging in the void, powerful and useless spaces at the same time, of strange proportions that their tension and disproportion turn them into magic”. (Bofill in D’Huart 1984 p.81).

References

Aa.Vv. (2016). *Ricardo Bofill a Taylor made world*. Barcelona, España: Random House Incorporated.

Architectural Design (1975). *Taller de Arquitectura*. Vol. XLV.

Baldellou, M. A., & Capitel, A. (1995). *Summa Artis. Historia General del Arte Vol. XL Arquitectura Española del Siglo XX*. Madrid, España: Espasa-Calpe, SA.

Bofill, R. (1989). *Espaces d’une vie*. Francia: Odile Jacob.

Bofill, R., et al. (1968). *Hacia una formalización de la ciudad en el espacio Barcelona*. España: Blume.

Bofill, R. et al. (1985). *Ricardo Bofill: taller de arquitectura*. Tokyo: A.D.A.

D’Huart, A. (Ed.) (1984). *Ricardo Bofill. Taller de Arquitectura. El dibujo de la ciudad. Industria y clasicismo*. Barcelona, España: Editorial Gustavo Gili SA.

CHAPTER 2

James, W. A. (1988). *Ricardo Bofill. Taller de Arquitectura. Edificios y proyectos 1960-1985*. Barcelona, España: Editorial Gustavo Gili SA.

Muntañola i Thornberg, J. (1988). Bofill 'classic': un templo profano. Nueva Figuración. In *Arquitectura Viva*, No. 2, pp. 14-16.

Norberg-Schulz, C. (1998). *Intenciones en arquitectura*. Barcelona, España: Gustavo Gili.

Postiglione, G., & Acerboni, F. (2004). *One Hundred Houses for One Hundred Architects*. Köln: Taschen.

Prost A., et al. (1991). *Historia de la vida privada. 9, La vida privada en el siglo XX*. Madrid, España: Taurus.

Rodell, S. (2008). *The influence of Robert Venturi on Louis Kahn*. Master of Science (MS) thesis in Architecture. Degree Supervisor Prof. D. Wang. Washington State University.

Solé I Ubeda, J.L, & Amigò, J. (1998). *Walden 7 i mig*. Barcelona, España: Ajuntament de Sant Just Desvern.

Interventions in the old municipal slaughterhouse of Valladolid: dialogues and socialisation

Alberto Grijalba Bengoetxea

In 1874, the Valladolid City Council decided to relocate the city's slaughterhouse, located in a large house on the right bank of the Esgueva in a place called Las Carnecerías and later Calle del Rastro (González, 1901). In 1894, a new slaughterhouse designed by Ruiz Serra was inaugurated in the vicinity of the provincial hospital. It was soon rendered obsolete by the increase in demand and the demands of new hygienic conditions required by society, which, for example, were reflected in Sanz Egaña's publication, *El matadero público (The Public Slaughterhouse),* in 1921.

In 1925, the municipal council debated whether to extend and renovate the existing building or to build a new one on a different site. After agreeing that the most convenient solution would be to build a *new one*, it was decided to promote a design competition for a modern facility. According to the agreement, the new facility should not be far from the city, but close to the river Pisuerga. At the same time, it was decided that it should be located downstream and with a sufficient flow to be able to carry out the washing and cleaning tasks described in all the hygiene manuals.

The 1925 competition

On 11 December 1925, the terms and conditions of the competition were published. In June of the following year the decision was made public, and the winner was the industrial engineer Alberto Colomina y Botí. Among the members of the jury, Modesto López Otero, director

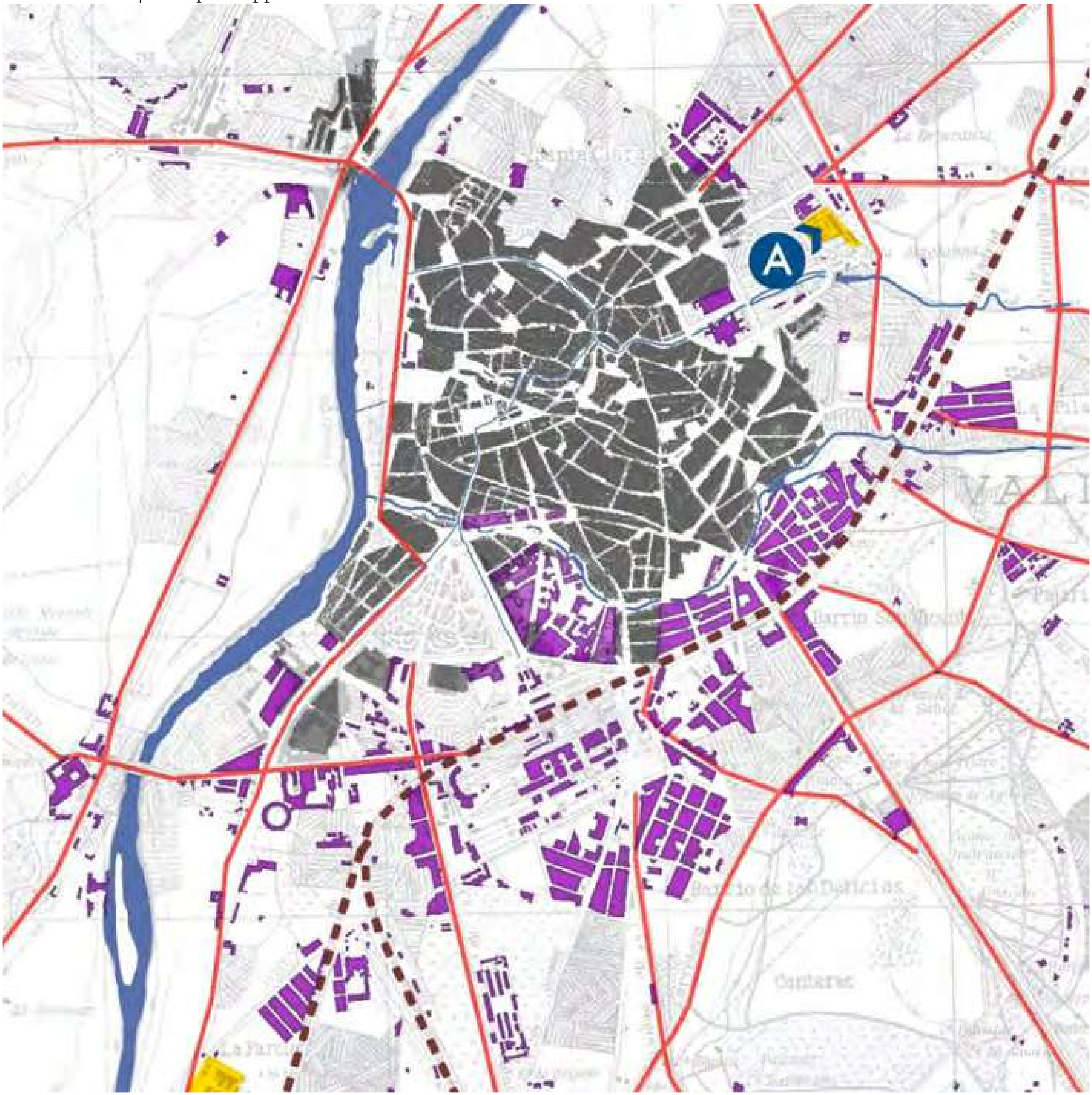

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Fig. 2. Slaughterhouse of Valladolid. Project elevation 1925 (image: Colomina and Botí).

of the Madrid School of Architecture, explicitly defended the so-called rationalist currents, exemplified in another of the projects submitted to the competition, that of Blein and Hidalgo. According to the minutes, this defence of industrialism was also endorsed by the municipal architect Juan Agapito y Revilla. These two members of the jury valued Blein and Hidalgo's proposal positively for the rationality of the approach to the circulations in relation to the uses, exemplified in the materials chosen and in the structural coherence of the complex. Their reports also highlighted the application of the hygienist criteria of the beginning of the century linked to the presence of natural light, ventilation, easy cleaning, durability, and non-combustibility: "The structural system chosen. Reinforced concrete with large bays; simple choice, sober walls without useless things... modern and beautiful" (Virgili, 1979).

However, in the end, Colomina and Botí's project was chosen for its industrial study, the appropriate arrangement of its parts and its resolution as a factory container, rather than for its architectural design solution. Let us not forget that Colomina was not an architect. In the reports and minutes, the winning project is described as having an antiquated image, with unnecessary elements and a bad appearance. Of the panels presented in the competition, the project still adheres to the eclectic taste of the 19th century and therefore refers to the factory architecture of the end of the previous century. In the project finally built in 1932, all this seems to have changed. Colomina considered all the jury's recommendations,

Fig. 1. Map of the layout of the city of Valladolid showing the location of the old slaughterhouses (drawing: Linazasoro, Grijalba, Grijalba, Carazo and Gil).

Fig. 3. Slaughterhouse of Valladolid. 1930 (image: Colomina and Botí).

while maintaining the characteristics of factory organisation that were so highly valued for his first prize. The project is transformed into an industrial building stripped of the useless and antiquated elements denounced by López Otero. The management of the project lasted from 1925 to 1931. In the various documents in the Municipal Archive, cited by María Antonia Virgili, the delay in the management until its construction is attributed to the reduction in size of each of the elements and the suppression of a livestock market that accompanied the initial project. Undoubtedly, all these changes meant that some forty years later, the facilities were insufficient for a growing city like Valladolid. The original model vision proposed by the organisers of the competition was weighed down by administrative decisions. A facility that claimed to speak of the future would prove to be insufficient in the last third of the 20th century.

The project built in 1931

There are undoubtedly two driving forces behind the change that led Colomina y Botí to introduce a new epithelial aspect to the ensemble. Firstly,

Fig. 4. Slaughterhouse of Valladolid. State 1996 (image: Colomina and Botí).

the dissemination of the *International Exhibition of Industrial Decorative Arts* held in Paris in 1925. It specifically called for the construction of a new modernity associated with a new inspiration and a new originality. In this respect, the decisive influence of the *L'Esprit Nouveau Pavilion* presented by Le Corbusier should be remembered.

Secondly, modernity in Spain had had its first manifestations coinciding with the same years. In 1929, Aizpurúa y Labayen's Club Náutico de San Sebastián was inaugurated. In 1932, this building was part of the exhibition *The International Style* at the MoMA, curated by Johnson and Hichcock. GATEPAC, on the other hand, was founded in October 1930 as the Spanish branch of C.I.A.M. From 1931, as part of the diffusion of modernism in Spain, the group published the influential magazine *A. C. Documentos de Actividad Contemporánea.* In 1925, Le Corbusier in his book *L'art décoratif d'áujourd'hui* introduced his well-known theory of the white wall, which is presented as a method of redefining the identity of architecture itself from its approach to its fundamentally visual attributes. The main argument culminates in the chapter entitled "A whitewash of

Fig. 5. Slaughterhouse in Valladolid. Amalgam of additions, 1996 (image: Colomina and Botí).

lime: Ripolin's law"; however, to the visual condition of the white, charged with attributes of honesty, sincerity and purity, another no less important one is added: "stopped" time. White in opposition to the passage of time. A virtue that allows it to escape from Chronos and seek the eternity associated with the absence of change. Thus, the colour white is a symbol of the perennial, the universal in space and the eternal in time. Following these principles, the built project of the Slaughterhouse assumes a condition of dematerialisation and of stopped time, abandoning the exposed brick used until then in factory constructions in favour of a certain epithelial rationalism of the white.

However, the complex had arrived at the end of the 20th century as a disorganised amalgam of buildings of varying quality, the product of numerous disorderly interventions that altered the spirit of the complex. Nevertheless, it still retained the essential elements of the original project of the early 20th century. These elements can be exemplified in two ways:

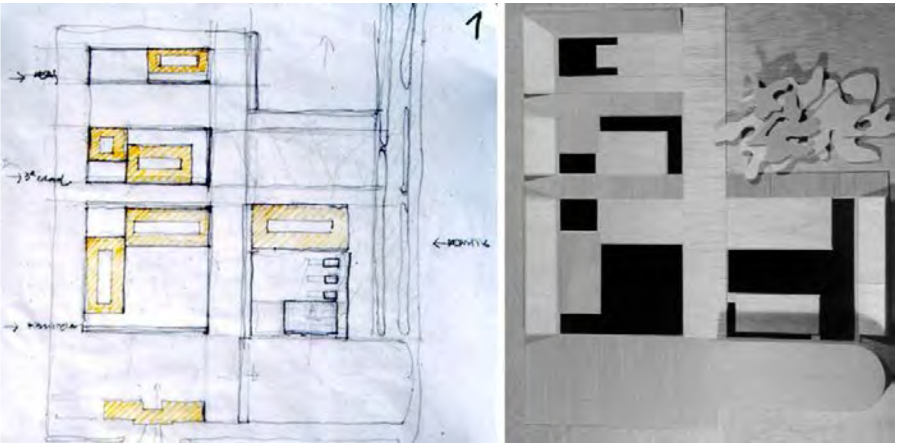

Fig. 6. Slaughterhouse of Valladolid. Sketch and model, 1996 (drawings: Linazasoro, Grijalba, Grijalba, Carazo, and Gil).

the idea of an enclosed enclosure, for security reasons, and the use of basilica-type structures that housed the main functions.

The 1996 contest. Time is a strange country

In 1996, the Valladolid City Council announced a new National Architecture Competition aimed at transforming the large block that made up the area occupied by the disused Industrial Slaughterhouse, which was to be converted into an Integrated Services and Equipment Centre. The freedom granted by the City Council in establishing the terms of the competition led to a wide variety of proposals, most of which included the complete demolition of the complex, which meant the disappearance of the memory. In our case, we opted for a mixed approach that orbited around the conservation of the most singular elements of the original constructions, which were none other than those of the basilica type that housed the main functions, and the dialogue with the new constructions incorporated that completed new interior blocks, with which the enclosure sutured the edges and opened to the city. Our proposal was the winner. The project was presented as authors by José Ignacio Linazasoro, Julio Grijalba, Alberto Grijalba, Eduardo Carazo, and Paloma Gil. At all times our intention was to reflect on time and the contemporary. The apparent

Fig. 7. Antique tea bowl repaired using the kintsugui technique (https://www.inran.it/wp-content/uploads/2022/12/kintsugi-3.jpg).

doctrinal irrelevance of the past, in the contemporary present, heir to modernity, is a widespread phenomenon but one that has had a particular impact on architectural thought. David Lowenthal (1998) refers to this explicitly in his essay *The Past is a Strange Country*. In it one can trace the three fundamental arguments for the generalised exclusion of the past, and by extension of time, in our current thinking. The first is the abrupt rupture between past and present, the second is the distancing from the past, and the third is the homogenisation of the past.

Procedure 1. The gold carpentry

In 15th century Japan, a powerful Shogun named Ashikaga Yoshimasa saw two antique tea bowls from his favourite collection smashed to pieces. Disgusted by the situation, he thought of a way to repair them. He sent them to China, home of famous porcelain ceramists, but the result was not to his liking. The bowls came back repaired with rude metal staples that made them unpleasant and did not respect the intrinsic value of the original ceramics, nor their sense of time, their lived time, which he ultimately wanted to preserve. He sought out Japanese craftsmen capable of restoring the lost splendour to a few shards of pottery. The key was not to try to recover the already fragmented unity, but to accept its condition. He ultimately found what he was looking for in *kintsugi* or gold carpentry. The technique consists of marking the break lines, stopping his time and filling the cracks with gold dust and varnish. Our project, first, eliminates the additions and fragments of unknown or altered origin. By eliminating these fragments, the joints are revealed and recovered, creating new empty territories that must be stitched together with new elements. These new fragments are not intended to compete with the inherited structures to be conserved, but their function is to complete a narrative, appropriating the voids generated in the same way as gold carpentry does, to stitch together and cohere the whole. From a voluntary formal and material restriction, the additions, like the *kintsugi*, accept their condition of uniting, but not from mimesis or simulation, but from specialisation and differentiation. For this reason, the blocks are

Fig. 8. Valladolid Slaughterhouse, 2010 (image: Linazasoro, Grijalba, Grijalba, Carazo and Gil).

completed with canopy buildings of exposed concrete and natural stone slats. Ultimately, it is a question of recovering and continuing the guiding task present in the reformulated 1931 project.

Procedure 2. Type persistence

As Leibinz states, time, as a universal order of transformation and change, is an order of successions and brings us closer to the knowledge that we attain through time series. Its importance is given to the dating or representation of time, as developed by Focillon and Kubler in their studies linked to the history of art. In this way, they both proposed the configuration of architectural series throughout history that allow us to define time according to their belonging to each one of them. Finally, they explore the relationship between object and subject in reference to the model, as a lesson of a "continuum" in architecture, or, in other words, the continuity of the guiding tasks of the project over time. Important contributions are known, but always from a fragmentary, non-inclusive point of view. These include Choisy, Sedlmayr, Jantzen and George Kubler's influential work *La configuración del tiempo*. More recently, we can highlight the contributions of José Ignacio Linazasoro in *Escrito en el tiempo. Thinking architecture*. The central discourse in all of them is oriented around the idea of belonging to an uninterrupted chain of series in history, and therefore to the architectural project as a *continuum over*

Fig. 9. Slaughterhouse of Valladolid. Interior of the building, 2010 (image: Linazasoro, Grijalba, Grijalba, Carazo and Gil).

time. The fundamental difference is what goes from the *morphé* in the former to the Albertian *eidos* of the latter. Thus, Linazasoro proposes the overcoming of the stylistic from a new orientation between subject and object that modifies the more pure-formal approaches, associated with the unity of the architectural object, in favour of a sequential vision of integration, where there is also room for a mental play of references.
The guiding idea of the 1996 project is to recover all the buildings that correspond to the basilica type. To this end, from the first sketches of the project, these take on an essential role in the configuration of the

Fig. 10. Slaughterhouse of Valladolid. Interior fragment, 2005 (image: Linazasoro, Grijalba, Grijalba, Carazo and Gil).

new open area. The relevance in our project of the original type and its preservation was based on two characteristics: its functional adaptability over time and its imprint on the volumetric perception of the complex now converted into a new institution.

Procedure 3. Palimpsest

By palimpsest we mean a manuscript that still preserves traces of the previous writing on the same surface, but expressly erased to make room for the one that now exists. Cardinal Angelo Mai, custodian of the Biblioteca Ambrosiana and chief supervisor of the Vatican Library, at the beginning of the 19th century managed to ensure that this superimposition of times was reflected simultaneously in a single present time. It is the representation of the paradox of time in constellation, the observation of different times perceived from the same position.

"*Burnt Norton" is the first of T.S. Eliot's Four Quarters, published in 1936. There, we found the following statement: "The present time and the past time are perhaps both contained... the present in the future time... and the future time in the past time. If all time is eternally present all time is retrievable*".

Our project echoes this passage from Eliot. It attempts to reconcile the different times, past, present, and future. The past is represented by recovering the essence of a project from almost a century ago that attempted to adhere, albeit epithelially, to the attributes of the desired modernity linked to dematerialisation and the suspension of time. The present, already distant since 1996, when we won first prize in the national competition, was evoked by incorporating new fragments from a voluntary attitude in which silence became the subject of the project. The present as a reflection on the meaning of completing what has been inherited. Finally, the future, making it possible to embrace a narrative of the diverse in the unitary, to which the dialogue between movable and immovable elements is no stranger.

Conclusions. Fragments

For Borges, every place is archaeological; if we subject it to excavation, we will find in it the ruins of ancient constructions, fragments of the thoughts of those who have preceded us. These sediments are displaced and mutilated words or the words of others. They form the basis of culture as an ultra-personal fact, as something that has value precisely because it belongs to no one. As if it were a Borges tale, the preservation of fragments constructs a new time in which the meaning of architecture no longer refers to a single great story. It is necessary to express oneself through a plurality of more discrete stories that intertwine and propose a polyhedral way of seeing our condition of belonging to a collective memory, which ultimately derives from the lost order. The past thus understood is a material that presents infinite plasticity, capable of receiving the most diverse forms, very different from the somehow irreparable past that a discipline such as history investigates, and which would come to be the authentic one.

Extracted from the project report

Below is a fragment of the original memorandum of intentions of the 1996 competition, which in our opinion has not lost its validity and is allowing us to complete fragments of the project over time, reaching up to the present day, as we are currently drafting the project of what is perhaps the last of the fragments.

Character: it is a question of intervening in a group of buildings of an industrial nature. Therefore, dignifying the complex and adapting it to a new cultural and recreational use means, on the one hand, restoring it and, on the other, finding an architecture that responds to this without destroying the character of the pre-existing buildings.

Rationale: the intervention is only justified based on the preservation, if not total, at least most of the buildings of the Old Slaughterhouse.

Economy: the two criteria set out above also express an essentially economic approach, both because of the desire to make the most of as much of what already exists as possible, and because they propose a unitary intervention, based on criteria of simplicity and constructive repetition.

An urban proposal: to understand the Slaughterhouse space, made up of free-standing pavilions, as an urban area to be promoted as such, incorporated into the city.

To this end, an urban grid is proposed, delimiting the buildings by means of streets and squares. The new buildings consist of the existing pavilions and the new additions.

A normalised and unitary construction: based on a prefabricated structure for all the added buildings, as well as continuous façades for all of them, which reinforces its own image as an addition and its industrial character.

An opening to the city: removing the existing fences and making the complex permeable to the immediate surroundings through the new interior grid of streets and pedestrian routes.
A clear and simple language: based on a repeated constructive resolution for the whole ensemble, whereby the new can be distinguished from the pre-existing without destroying the unity of the ensemble, but rather creating a new unity based on this contrast and superimposition.

References

Eliot, T. S. (2021). *Four quartets*. Madrid: Alianza.

García Grinda, E., & Solá Morales, I. (1998). *Josè Ignacio Linazasoro Contemporary Spanish Artists Collection*. Madrid: Argentaria Foundation.

González, C. (1901). *Valladolid sus recuerdos y sus grandezas (Valladolid, its memories and its greatness), Vol. II*. Valladolid: Rodríguez Hernando.

Le Corbusier (1925). *L'Art décoratif d'aujourd'hui*. Paris: Editions Crès.

Linazasoro, J. (2009) *Written in time. Thinking architecture*. Buenos Aires: Nobuko.

Linazasoro, J. I., Grijalba, J., Grijalba, A., Carazo, E., & Gil, P. (1998). Centro Integrado de Equipamientos. In *Arquitectos,* No. 146, pp. 66-69.

Linazasoro, J. I., Grijalba, J., Grijalba, A., Carazo, E., & Gil, P. (1998). Centro Integrado de equipamientos. In *Arquitectura Viva,* No. 59, p. 11.

Lowenthal, D. (1998). *The past is a strange country*. Madrid: Akal.

Quintans, C. (2009). *Catalogue IV Enor Architecture Award*. Vigo: Enor.

Sanz Egaña, C. (1921). *The public slaughterhouse. Construction. Installation. Government*. Barcelona: Revista veterinaria de España.

Virgili, M. A. (1979). *Urban and architectural development of Valladolid (1851-1936)*. Valladolid: Ayuntamiento de Valladolid.

Analysis for the intervention, rehabilitation and reuse of buildings of patrimonial value of industrial origin. The case of the Giesa Factory in Zaragoza

Luis Agustín-Hernández, José Ángel Gil-Bordás, Marta Quintilla Castán

Introduction

Industrialization in Spain, somewhat delayed compared to England, Northern France, Southern Germany, and Northern Italy, began with an incipient industry during the 19th century, mainly derived from the transformation of agricultural products and mining, except for the scarce textile experiences in the Barcelona area, the blast furnaces near Bilbao, and the vicinity of Valencia with the blast furnaces of Sagunto, Zaragoza will not be oblivious to the national reality and will have abundant flour mills, sugar mills, and industries for the transformation of basic products, textiles, leather, and footwear. This development, although slow and steady, reaches the 20th century with numerous projects and product diversification. However, this process will be interrupted by General Franco's military uprising, which, despite taking the city with little resistance, will plunge the local industry into self-sufficiency, lack of materials, and limited export possibilities. After autarky and with the support of the United States, Spain joined most of the international organizations: the UN (1955) and probably the most important for the national industry, the General Agreement on Tariffs and Trade (1963), which had been founded in 1947 under the auspices of the UN and which would be the germ of the World Trade Organization. The international situation and the entrepreneurship of bussinessmen from the city and the surrounding area will make a new industry flourish, fundamentally oriented to the transformation of metal, mechanics, electrical products, the transformation of consumer products, a large logistics industry and a strong chemical industry. In this environment, in 1947 the G.I.E.S.A. factory, Guiral Industrias Eléctricas, S.A., was created in honour of its founder, which was dedicated to the construction of electric motors and essentially to the manufacture of lifts.

Architectural Survey in Industrial Heritage

For any intervention in a pre-existing building, it is essential to have geometric and constructive knowledge, as well as the materials that make it up and an exhaustive detail of its style and background, which is achieved through previous documentation and study. The geometric shape at the moment of making the survey and the deterioration suffered by the passage of time provides an accurate record of the current moment, which, using constructive and compositional criteria, leads us to the intervention on the building. This exact replica, with millimetric or even sub-millimetric values, is highly valued and a great tool for work in the intervention of heritage buildings in general. However, when it comes to industrial buildings, it can be more of a problem than a solution, because excessive precision can lead to errors. The virtual model that will be generated, as indicated by architect Luis Franco-Lahoz, must take into account that there are plans drafted by an architect. Although the details may be very concise or nonexistent, there is a general planning, a series of modules or construction guidelines that repeat with the technology available at the time of construction. It is also important to consider that there are multiple elements, generally structural, that are standardized, such as metal profiles, panels, etc. This will be necessary to create a correct architectural model exportable to Hbim technology, which can simulate the mechanical characteristics of the structure and the thermal or acoustic properties of its envelope.

To carry out the survey, the research group decides to combine both terrestrial and aerial photogrammetry technology with laser scanner technology for precise point capture. Subsequently, a digital twin will be created using Hbim technology.

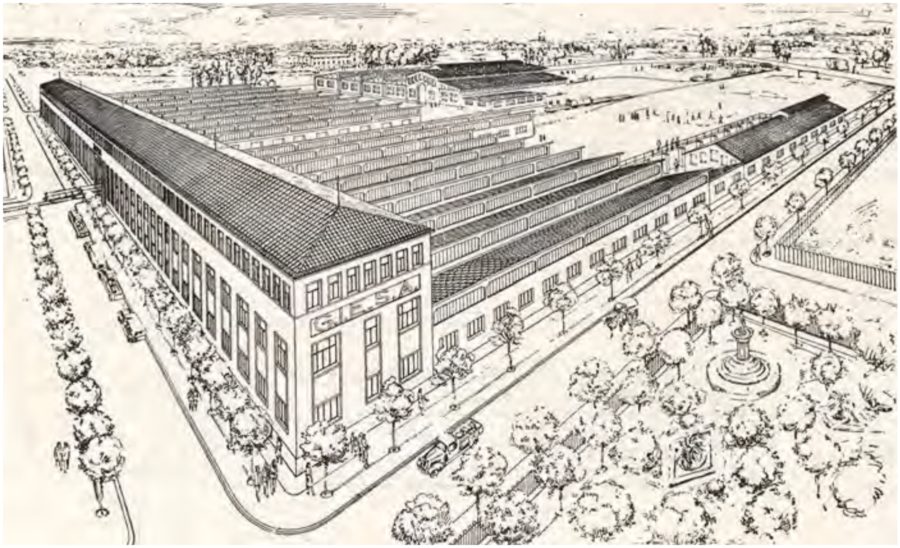

Fig. 1. Overview of Giesa (source: Revista Nacional de Arquitectura, nº 30, 1944).

There is little bibliography on surveys of industrial heritage buildings, but they address the use of multiple techniques to achieve satisfactory geometric and colorimetric results in buildings with highly variable lighting. This is indicated in the article: Graphic survey of active industrial heritage: Nueva Cerámica de Orio. Therefore, it has been considered necessary to test modern techniques for massive point capture and geometric registration using different tools that allow for the creation of a three-dimensional model; specifically, the use of street-level and aerial photogrammetry (assisted by drones), and 3D laser scanning (Senderos, 2019).

The history of the Giesa factory and previous documentation

Joaquin Guiral, a technical engineer from Huesca, acquired in 1942 land on which to build the Guiral Industrias Eléctricas, S.A. factory known by its acronym: “G.I.E.S.A.” which had been founded in 1940, with the idea of building a factory dedicated to the development of electromechanical projects, although it finally specialized in the vertical transportation of

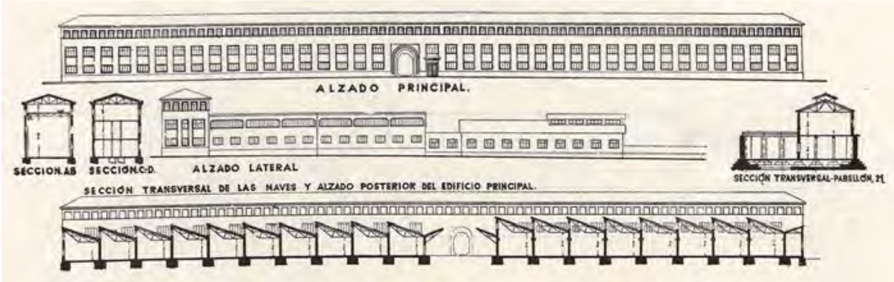

Fig. 2. Elevations and sections Giesa (source: Revista Nacional de Arquitectura, nº 30, 1944).

people in buildings, focusing on the elevator sector, being a national reference. The lands were located next to the national Zaragoza-Castellón highway, in the well-known neighborhood of Las Fuentes, and come from the sale of the property known as Villa Asunción. These had an area of almost eleven hectares and corresponded to the estate called Villa Asunción, which included the palace built by the shipowner Miguel de Larrinaga in 1901 (Mendoza, 2020). The construction project of the new factory was entrusted to architects Miguel Ángel Navarro Pérez and José Luis Navarro Anguela, who were responsible for the design and construction. Although it was initially planned in three phases, ultimately more architects participated in its completion. Fortunately, in 1944, Miguel Ángel Navarro Pérez, architect, and co-author of the project, published an article in the National Architecture Journal (ISSN 0211-3376, No 30, 1944, p 225) about the GIESA project, with abundant graphic documentation that captures the intervention. The project included the factory itself, located between San Joaquín streets, two newly opened roads, and an urban intervention dedicated to housing for the workers' homes, following the German or Catalan models of workers' colonies.

Regarding the industrial complex, it occupied 32,000 m^2 of surface area with a reserved zone for future expansions. It was surrounded by 12-meter-wide streets and had direct access from the highway, as well as an axial connection through another 16-meter-wide street. Additionally, it had railway sidings (Biel, 2003). Part of this property was designated for residential development. In fact, the plot included a reserve for building

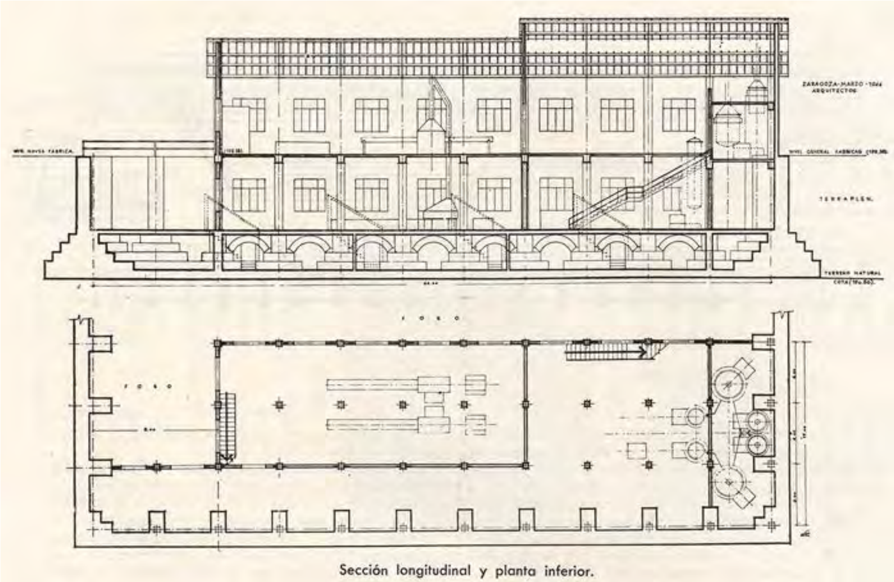

Fig. 3. Plan view and section. Main building Giesa (source: Revista Nacional de Arquitectura, nº 30, 1944).

1,000 worker housing units under the reduced rent regime, protected by the National Housing Institute (Mendoza, 2020). However, the housing project was never carried out due to lack of municipal involvement in the intervention. The eminently rationalist project articulates the spaces in BUS, hanging from a main building constructed with reinforced concrete for the vertical load-bearing structure and foundations, using one-way slabs in a 7-meter module for the upper floors, and covering the building with a lightweight structure made of metal trusses. This building houses the production plant on the ground floors, resembling a railway terminal where the product travels along the line until it reaches the end where it is finished. In the central area, there is a large hall with an overhead crane for moving heavy goods, and this hall is accessed through the main door, the corporate goods entrance. Additionally, the building on San Joaquín Street also includes offices, management, and the technical office, as well as other minor dependencies. The complex also features an air raid shelter, reflecting the time when it was constructed.

The façades are made of brick, partly exposed and partly covered, vaguely reminiscent of traditional Aragonese and Zaragozan architecture. From this main building with two floors, the workspaces hang linearly on one side, predominantly open-plan buildings with metal pillars and trusses in a sawtooth roof shape, facing south to allow good lighting in the work areas. Although the choice of such traditional construction systems and that certain picturesque popular bias may be more related to the scarcity of modern materials, characteristic of a period of self-sufficiency and maximum isolation (Mendoza, 2020). During one of the final phases of construction, a 6-story tower was built, which added character and identity to the complex. Inside, there was an elevator testing tower, further emphasizing the technological aspect of the company. "The relationship that the Swiss multinational Schindler established with GIESA will be particularly significant, as the latter began manufacturing under the Group's license starting in 1946. Joaquín Guiral passed away in 1950, leaving behind a solid trajectory visible in the company he had created in 1940, which was ultimately merged with the Schindler multinational in 1986. In 2005, an agreement with the City Council led to the relocation of the factory from its initial location to the Empresarium Industrial Park in La Cartuja Baja, Zaragoza, where modern facilities were inaugurated a year later. The old factory was acquired by a developer with the intention of building 334 housing units, while also preserving the architecturally significant area for eventual public use by the City Council". (Mendoza, 2020).

Municipal objectives

After the transfer of the Architectural Heritage Asset of the GIESA factory to the Zaragoza City Council, the council intends to rehabilitate the building and change its use to create a community facility for the Las Fuentes neighborhood, establishing a new hub area in the former GIESA factory building. Zaragoza City Council under the name of the action: "Re-Use of Giesa and participation actions associated with the urban environment. Sociocultural and Socio-Technical Center for Hybrid

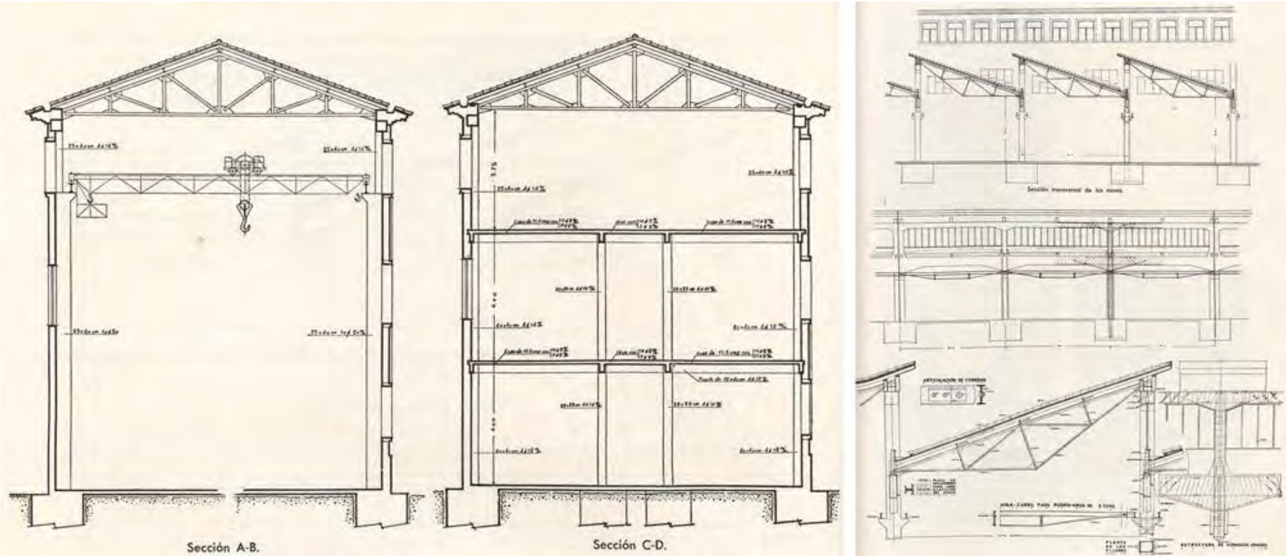

Fig. 4. Constructive sections. Giesa (soruce: Revista Nacional de Arquitectura, nº 30, 1944).

Uses. Barrio de Las Fuentes (Zaragoza). A building currently in disuse", carries out a process of citizen participation and, with the support of European funds, proposes a master plan for the reuse of the building where the most relevant actions are associated with energy efficiency processes, through the implementation of improvements in the thermal envelope and in the facilities system. It is proposed that the overall approach will mean that the New Giesa will be transformed into six large areas: a neighbourhood house, a socio-cultural centre, an open and digital square, multipurpose spaces, a co-working space, a residence for athletes and a high-performance centre that will serve as a sports facility for the neighbourhood. On the one hand, a Casa del Barrio (3,173 m2) has been designed at the front of the building that overlooks Calle de San Joaquín, in the area next to Calle de Padre Chaminade, which will have space for exhibitions, workshops and multipurpose rooms. The rest of the main building, towards Calle de Yolanda de Bar, will be the Casa de la Ciudad (2,412 m2), with exhibition halls, a multipurpose space, a large assembly hall divisible as an auditorium and storage for equipment.

Fig. 5. Director plan. Giesa (source: Zaragoza City Council).

The entire building on Calle de Yolanda de Bar will be used for the Co-Living area (2,016 m^2), which will have shared rooms and spaces, co-working areas and shared housing as a residence for athletes. That is the key to another of the great attractions of the project, given that a 3,495 m^2 High Performance Centre (CAR) will be built in the warehouses on Padre Chaminade Street, with regulation courts, a 25-metre swimming pool, gymnasium, changing rooms, classrooms and workshops. But it is also proposed as a facility for shared uses with the district, thus providing a solution to one of the great demands of the neighbourhood: a sports facility or pavilion open to the neighbourhood. The rest of the project will be created on Francisco Rodrigo Street, next to the pedestrian area behind the main building. There, on one side, the Digital Agora (1,495 m2) is proposed, a new construction dedicated to a media library, digital laboratory, multipurpose spaces, cafeteria, dining area, and administration area. And, next to it, the Natural Agora (3,953 m^2), or public square, with sports areas for adults and children's playgrounds. This specific area has already been executed.

The graphic documentation process of Giesa

Prior to conducting fieldwork, research and the search for existing graphic information about the building were carried out. In order to understand the building and create an appropriate documentary record, it is essential to conduct a preliminary study that provides the necessary knowledge to formally interpret the different construction stages that formed the architectural ensemble, and thus identify the aspects that need

Fig. 6. Plan director. Giesa (source: Zaragoza City Council).

to be addressed in the record. Firstly, the project drafted by architects Miguel Ángel Navarro Pérez and José Luis Navarro Anguela, approved by the College of Architects, was located. This project contains the original project's plans subject to protection. Additionally, the Zaragoza City Council provided plans for the drafting of the master plan for the building's reuse, which was submitted for European Next Generation funds within the Recovery, Transformation, and Resilience Plan (PRTR). This documentation, carried out by the City Council technicians through on-site measurements using a distance meter, reflects the successive additions of industrial structures made later on. While the original project documentation holds significant value, it does not accurately depict the current reality of the factory, unlike the competition plans, despite the detected precision errors. Fieldwork continued the work initiated during the previous phase of information source research. To collect data, it was necessary to take into account the formal characteristics of the building and its immediate surroundings, with the aim of anticipating any potential disruptions during the capture and recording process. One notable factor that hindered the survey was the size. The complex has

Fig. 7. Aerial view -Restored. Giesa (source: the authors).

an approximate area of 5,600 m², with open, empty, elongated floors and a significant amount of façade surface. Most of these areas lack interior lighting, as the windows are boarded up for security reasons. Additionally, some spaces have triple heights, which complicates their recording. On the exterior, both the main façade and the side facades are limited by narrow streets with large trees closely located. This complexity has affected the selection of appropriate tools for data collection, as well as other criteria such as scope, level of detail, time, and economy. Considering the formal characteristics of building typology, data capture included exterior elevations of walls, as well as roofs and the tower. Inside the building, information on spatial organization and structure was necessary, with lattice work difficult to record due to the height of the spaces. Before determining the techniques used in the survey, several factors were taken into consideration, such as the level of detail required, the skills and experience available in different recording methods, the definition of the time frame, and the desired outcomes. The scope of the project was designed to balance all these factors with the constraints of available time and economic resources (Lo Brutto et al., 2014; Achille

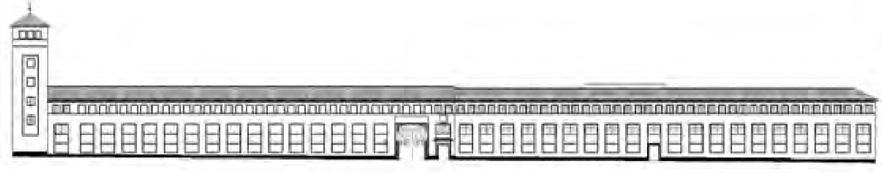

Fig. 8. San Joaquín Street elevation. restored. Giesa (source: the authors).

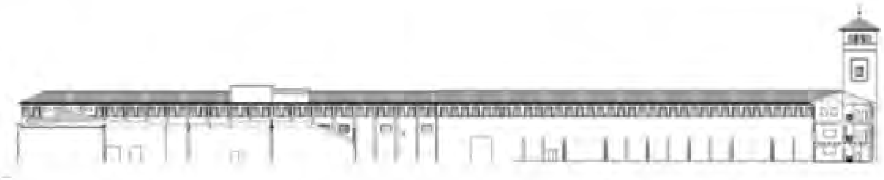

Fig. 9. Complete section. Giesa (source: the authors).

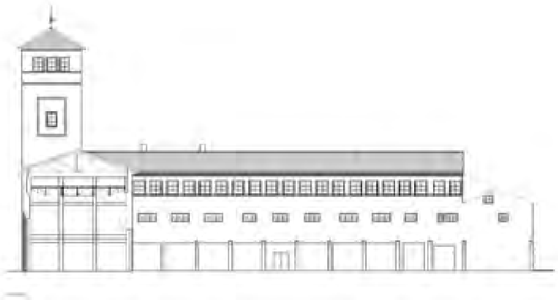

Fig. 10. Constructive section. Giesa (source: the authors).

et al., 2015; Fatta et al., 2017). The definition of the desired level of detail and precision for the resulting graphic information was crucial in the selection of methods and tools to be used. In the specific case of the GIESA factory, given its particular characteristics, the need to achieve a high level of detail was deemed necessary. An approximate precision of ±2 mm for construction details and between ±10 mm and 25 mm for the construction planimetry was established as the objective. These parameters were fundamental in guiding the selection of the most appropriate survey techniques and ensuring the acquisition of accurate and complete data. For a comprehensive survey of the buildings, both their exteriors and interiors, a combination of acquisition techniques was employed, such as photogrammetry and laser scanning, carried out in

Fig. 11. Orthophotography - restored. Giesa (source: the authors).

three stages. The choice of survey method was based on considerations such as limited accessibility near the buildings and specific architectural features that require a high level of detail (Barba et al., 2019; Diara & Roggero, 2022).

Initially, in the first stage, a Faro 3D_HW_LS_Focus M 70 laser scanner was used to capture additional data. This scanner allows for the acquisition of photorealistic textures and mappings with a precision of ±3 mm and a range from 0,6m up to 70 m, making it ideal for short-range measurements and applications in confined areas. The Faro 3D_HW_LS_Focus M 70 has a wavelength of 1550 nm, a color resolution of up to 165 megapixels, and a wide field of view of 300º vertical and 360º horizontal. Additionally, it is equipped with a dual-axis compensator with a precision of 19 arcseconds within a ±2º margin, as well as a height sensor using electronic barometer, compass, and integrated GNSS with GPS and GLONASS. A total of 234 scans were carried out, including 177 indoors, 3 in the transition zone between interior and exterior (next to the door threshold), and 54 outdoors. It took several weeks to complete enough scans to capture the entire building. Due to the building's characteristics, spheres were used to facilitate the alignment of the scans later using Faro's Scene software. The point cloud density obtained was 5 mm, and information was captured not only in volumetric terms but also in terms of color, in order to accurately record data from both the interior and all façades of the building.

As a complement to the laser scanner, in a second stage, photogrammetric surveying of the roofs was carried out using an Unmanned Aerial Vehicle (UAV) in order to complete the three-dimensional registration of the buildings. 1734 photographs were taken at 5280 x 3956 pixels, allowing for comprehensive capture not only of the roof but also of the facades, in this case, unlike the scanner, from a high altitude. The model used is the DJI Inspire2, a device that offers great agility, capable of reaching speeds from 0 to 80 km/h in just 5 seconds, with a maximum speed of 94 km/h and a maximum descent speed of 9 m/s. In addition to its ability to operate in low-temperature environments, the DJI Inspire2 is equipped with a collision protection system in two directions and can transmit live video from both its onboard FPV camera and its main camera simultaneously. The proximity to neighboring buildings and the atmospheric conditions of the authorized flight day did not allow for obtaining photographs with sufficient oblique angle to capture the front and side façades in their entirety. Therefore, it was necessary to complete the survey using terrestrial photogrammetry. In a third stage of work, the registration process was complemented with terrestrial photogrammetry of the exterior of the building at street level. It was necessary to take 761 photographs at 4272 x 2848 pixels, mainly of the main and side façades, since they were obstructed by trees and the narrow streets, preventing the drone from capturing sufficient angles of the lower part of the façades. To complete this information, data was collected using a Nikon D5600 camera equipped with a large DX format image sensor of 242 megapixels, paired with an AF-P DX 18-55mm VR lens.

Results

The integration of data collected from both the interior and exterior of buildings through photogrammetry and laser scanning results in a complete three-dimensional geometric model, providing a detailed representation of the buildings' geometry and shape. The acquirement of the three-dimensional model began with the combination of information recorded through both terrestrial and aerial photogrammetry. The process was carried out using Agisoft's Metashape software. The information provided by the photographs facilitated the creation of a textured three-dimensional model from which realistic orthophotos of elevations and roofs with metric quality were obtained.

The process of point cloud model generation involves the integration of photogrammetric and laser scanning data, which are combined and processed using Faro's Scene software. First, all parking lot scans were loaded into the software and aligned using common reference points. Subsequently, coordinates for various points in the model were obtained and assigned to corresponding points in the photogrammetric cloud, generated from ground and aerial photographs using Metashape. This process allowed us to align and scale the photogrammetric model precisely with the information obtained from laser scanning. Finally, this point cloud was imported into the Scene software, where it was merged with the rest of the scanned data, achieving a seamless overlap between all point clouds. The result is a high-density point cloud that provides accurate information about the geometry and color of the buildings, with a resolution of up to 5 mm. Additionally, the three-dimensional model allows for the creation of a CAD planimetry in order to geometrically define the overall assembly at a representation scale of 1:100. In this case, the Autocad program was used to obtain the desired views by applying rectangular cuts to the point cloud.

Conclusions

The graphic documentation of industrial architectural heritage has special characteristics due to the repeated elements, the quantity and diversity of materials used, such as brick, concrete, and plaster, for which a low point cloud density is required. For some materials like laminated steel, which is very thin, a denser point cloud is necessary for precision. Given the age and varying lighting conditions of these buildings, it is important to find chromatic values close to reality. Sometimes artificial lighting is needed to achieve these values, which can reveal traces or pathologies affecting the building or its structure. In conclusion, satisfactory results have been obtained from the integration of terrestrial photogrammetry, aerial technology, and laser scanning, by adjusting point density in different areas and using proper lighting. The work for the writing of this paper has been carried out in "Grupo de Representación Arquitectónica del Patrimonio Histórico y Contemporáneo. GRAPHyC", Ref: H32_23R. University of Zaragoza.

References

Achille, C., Adami, A., Chiarini, S., Cremonesi, S., Fassi, F., Fregonese, L., & Taffurelli, L. (2015). UAV-based photogrammetry and integrated technologies for architectural applications – Methodological strategies for the after-quake survey of vertical structures in Mantua (Italy). In *Sensors*, Vol. 15, No. 5, pp. 15520-15539.

Barba, S., Barbarella, M., Di Benedetto, A., Fiani, M., & Limongiello, M. (2019). Comparison of UAVs performance for a roman amphitheatre survey: the case of Avella (Italy). In *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, Vol. XLII-2(W11), pp. 179-186.

Biel Ibañez, M.P. (2003) Autarquía y Arquitectura industrial en Zaragoza. In *Artigrama*, No. 18, pp. 527-548.

Diara, F., & Roggero, M. (2022). Quality Assessment of DJI Zenmuse L1 and P1 LiDAR and Photogrammetric Systems: Metric and Statistics Analysis with the Integration of Trimble SX10 Data. In *Geomatics*, No. 2, pp. 254-281.

Fatta, F., Bassetta, M., & Manti, A. (2017). Survey Methodologies, Research and Technological Innovation for a Case of Medieval Archaeology: Torre Melissa in the province of Crotone. In *Disegnarecon*, Vol. 10, No. 19, pp. 6.1-6.17.

Lo Brutto, M., Garraffa, A., & Meli, P. (2014). UAV platforms for cultural heritage survey: first results. In *ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci.*, Vol. II-5, pp. 227-234.

Mendoza, R. I. (2020). Las cubiertas de dientes de sierra. Escasos pero representativos ejemplos industriales en la Revista Nacional de Arquitectura 1941-1950. In P. Arza Garaloces, Jo. M. Pozo Municio (Eds.). *Los edificios de la Industria: icono y espacio de progreso para la arquitectura en el arranque de la modernidad*. Conference roceedings. Pamplona, 25-27 marzo 2020, pp. 361-368.

Senderos, L. M., Leon Cascante, I., & Pérez Martínez, J. J. (2019). Graphic survey of industrial heritage in activity: Nueva cerámica de Orio. In *EGA Expresión Gráfica Arquitectónica*, Vol. 24, No. 36, pp. 92-105.

Ombù: an innovative example of industrial building reuse project in Madrid by Foster + Partners

Gianluigi Freda

An abandoned industrial site is not an archaeological site, but an opportunity for a new urban development

For many years, in the cultural language code concerned with Architecture and urban heritage studies, the term "industrial archaeology" has been used when referring to abandoned industrial artifacts that retain architectural and stylistic features of a certain value. In reality, the use of the expression "industrial archaeology" becomes inappropriate when one focuses on the temporality to which the archaeological condition refers (Casamonti, 2022). The ancient or archaic time that permeates the existence of archaeological remains has nothing to do with industry and its production apparatus, which are essentially a modern legacy. Nor is the mystical aura glimpsed among the ruins of a classical temple comparable to the rust that invades the many industrial residues, rendered unproductive just a few decades ago and destined for a degradation that appears increasingly irrecoverable.

However, many of these abandoned buildings still possess spatial qualities and formal characteristics that are very valuable to the contemporary city. Moreover, they belong to collective memory and to the history of places, and reintegrating them into a new cycle of life appears to be a solution that aligns well with the contemporary sensitivity that the culture of architecture design is demonstrating towards the concept of urban circular reuse. The transformative approach, which represents its theoretical and practical foundation and is applied to the revitalization of

Fig. 1. Exterior view of building. Originally built in 1905 by the architect Luis de Landecho, the building once supplied energy to the surrounding areas. It later fell into disuse until ACCIONA acquired it in 2017, saving it from demolition, a fate that other similar structures in the area had experienced in recent years (image: © Nigel Young / Foster+Partners).

abandoned industrial sites, replaces the traditional linear model of "take, produce, dispose" with a regenerative system that seeks to minimize waste and maximize the value of resources. Within this approach, abandoned industrial sites, once unproductive and sterile, become the new hubs of a dynamic ecosystem of material flows, energy exchanges, and resource utilization.

Adaptive reuse and regeneration of industrial sites also make urban renewal efforts more effective in terms of environmental sustainability and

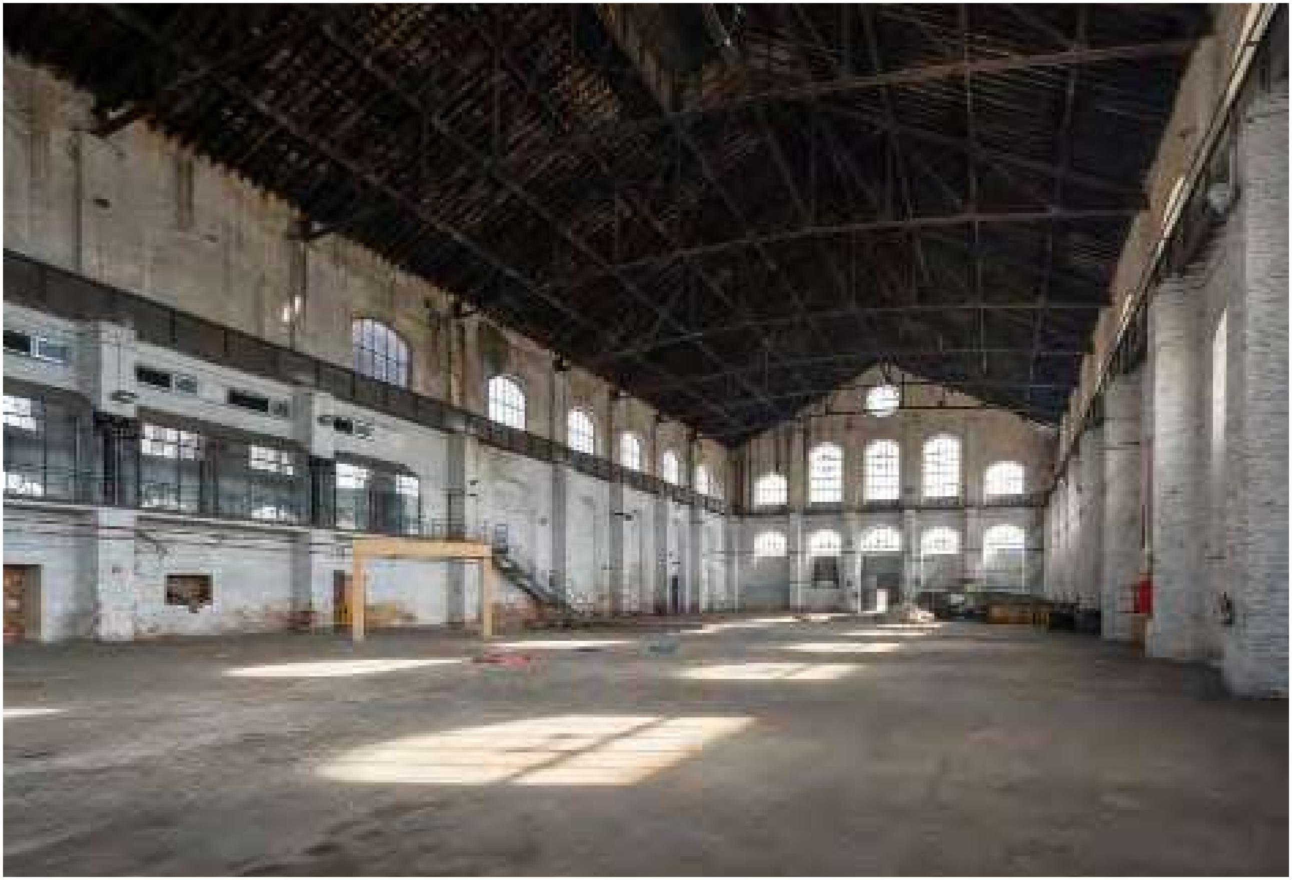

Fig. 2. Historic industrial building built in 1905 by Luis de Landecho (image: © Rubén Pérez Bescos / Foster + Partners).

cultural heritage preservation, using innovative design strategies through the intrinsic qualities of existing structures to minimize environmental impact and maximize the potential for social and economic revitalization. The reuse of abandoned industrial buildings, which exhibit conditions favorable to balancing the energy expended in their reactivation with the actual benefits for residents and the city in economic, functional, and environmental terms, is a design action that goes beyond mere physical transformation. It becomes an operation of high symbolic value,

Fig. 3. The lightweight structure inserted inside the space is made from sustainably sourced timber from local forests and allows for spatial flexibility (image: © Nigel Young / Foster+Partners).

especially when the buildings to be reactivated are located in marginal areas. These containers resurrected to new life trigger a process of revitalization for the entire neighborhood, generating new forms of productivity aggregation, especially of cultural origin.

The need to promote regenerative processes in architecture also contributes to the preservation of urban identity and represents a response sensitive to environmental issues. The reuse of industrial structures, adapted to new functions, indeed provides a sustainable solution to the excessive

use of land and the progressive and unstoppable depletion of resources. For many years now, international urban policies have promoted the development and sustainable use of resources. Europe is particularly sensitive to this issue, given the potential of reusing the many industrial buildings scattered throughout the territory in terms of safeguarding and saving land in historic centers. There are many documents produced by the EU that focus on deepening this topic. Among these, the Sustainable & Circular Reuse of Spaces & Buildings Handbook emphasizes that:
"As the available land is often scarce in cities and the urban sprawl is burdensome and costly, re-using existing buildings emerges as an alternative. Promoting re-use practices will help to ensure more sustainable urbanisation, with multiple benefits not only for managing authorities, but also for all citizens" (Urban Agenda for the UE, 2019, p. 12).
In light of this political approach, sensitive to environmental and urban issues, which materializes in the reuse of disused industrial heritage, there are many architectural project experiences moving in this direction in Europe. Some of these experiences have been carried out by internationally renowned firms that have also been able to interpret the theme of reuse in an innovative and exemplary manner for future projects. One of fhe most significant in this regard was the redevelopment of an industrial building in Madrid, elaborated by Foster+Partners Office in 2022.

Ombù: an Ark of innovation and environmental sensitivity

Not far from Madrid's Atocha Station, along Calle del Ombù, stands the majestic brick building stretching about a hundred meters in length, built in 1905 by the Basque architect Luis de Landecho on behalf of the Sociedad Gasificadora Industrial (Fig. 1). The large structure, characterized by neo-Gothic decorations, was intended to house the engine room, which, along with other industrial buildings in the area owned by the same company, provided power to part of the city.
Fallen into disuse and destined for demolition, in 2017 it was acquired by the Spanish infrastructure company ACCIONA, which commissioned Foster+Partners studio to transform the large empty shell with steel

Fig. 7. Exterior view of building. One of the most sustainable projects by Foster + Partners, the project was presented at COP26 in Glasgow as a case study for the World Green Building Council. Its environmental impact is compatible with the original 2°C aim of the Paris Agreement and its carbon footprint has been carefully measured and controlled. (image: © Nigel Young / Foster+Partners).

Fig. 4. The lightweight structure inserted inside the space is made from sustainably sourced timber from local forests and allows for spatial flexibility, while also integrating lighting, ventilation and other services (image: © Nigel Young / Foster+Partners).

Fig. 5. Interior view of building. The lightweight structure inserted inside the space is made from sustainably sourced timber from local forests and allows for spatial flexibility (image: © Nigel Young / Foster+Partners).

Fig. 6. The lightweight structure inserted inside the space is made from sustainably sourced timber from local forests and allows for spatial flexibility, while also integrating lighting, ventilation and other services. The timber structure will save more than 1,600 tonnes of CO2 and is recyclable and demountable. A central skylight brings natural light to the interior, reducing the need for artificial lighting, while the glazing incorporates photovoltaic technologies that generate electricity (image: © Nigel Young / Foster+Partners).

trusses into its office headquarters.
As stated by the studio, the retrofit operation aims to reintegrate a disused industrial building into the city's life and productivity cycle, preserving its historical and cultural identity.
At the core of the design intervention is the intention to preserve the integrity of the facades and to intervene only internally without modifying the layout volumetrically. Additionally, the project utilizes the existing load-bearing structure that supports the inclined steel trusses. The large interior space (Fig. 2), that seems to be a reminiscent of a cathedral nave, is cleared and restored, and within it, a large three-story wooden structure (Fig. 3) is placed to house the functions required by the client. Similar to an ark, containing precious objects, this structure is made from timber sourced from sustainably managed forests in northern Spain, providing spatial flexibility and integrating lighting, ventilation, and other services. The structure is supported by wooden pillars that free up space on the ground floor, allowing for unrestricted circulation

Fig. 8. Courtyard adjoining the building. Taking advantage of Madrid's temperate climate, the new courtyard offers the option to comfortably work outdoors (image: © Nigel Young / Foster+Partners).

(Figg. 4, 5), while existing windows in the envelope and a skylight in the pitched roof provide natural lighting and ventilation, ensuring great comfort during office hours.

The reuse and redevelopment operation, which finds its strongest symbol in the wooden structure placed inside (Fig. 6), also has a significant impact on the external areas, treated as a large surface in continuity with ACCIONA company's workspaces (Fig. 7). Carefully selected local flora minimizes water usage, drawn from nearby water basins. Therefore, the design of the outdoor space allows for extending the workspace outdoors, considering that for much of the year, Madrid's climate allows for pleasant outdoor stays. For the large 12,400 square meter park with 350 trees, only local species have been selected to reduce water consumption, sourced from local reservoirs (Fig. 8).

The park (Fig. 9) not only aims to increase comfort and enhance the quality of the workspace but also serves as an intermediate space between the building and the city, creating a continuity that had been denied until now

Fig. 9. Section sketch by Norman Foster. The building connects to a large 12,400 square-metre park with 350 trees featuring outdoor working spaces and areas for informal meetings sheltered by a green canopy of trees (image: © Norman Foster).

and allowing the community to have another large green and sustainable space at its disposal.

The project actions guided by a strong environmental ethic, supported by Foster+Partners studio, which has always been sensitive and at the forefront of this issue, can serve as a model and guide for future projects involving the reuse of disused industrial sites. In fact, the decision to preserve the industrial building, besides safeguarding the historical identity of the place, is the first action in environmental protection, as it allowed for the preservation, and therefore not dispersing into the environment, of over 10,000 tons of original bricks, thus immediately reducing the environmental impact (Fig. 10). The entire project aims to mitigate the environmental footprint, that is, the impact of human activities on the ecosystem. In addition to those previously mentioned, there are many design actions that ensure the offices designed by Foster+Partners have a very high quality in terms of safeguarding environmental resources, which can become an operational model for future reuse projects, not only for abandoned industrial buildings but also for the many disused urban containers present in the urban areas of many European cities.

It is estimated that the wooden structure located in the center of the space of the large industrial building, recyclable and dismantlable, will save more than 1,600 tons of CO2. Additionally, the central skylight,

Fig. 10. Interior view of building. The historic building envelope has been retained to conserve over 10,000 tonnes of original brick and mitigate the environmental impact. The lightweight structure inserted inside the space is made from sustainably sourced timber from local forests and allows for spatial flexibility (image: © Nigel Young / Foster+Partners).

bringing natural light inside, reduces the need for artificial lighting. Furthermore, the windows incorporate photovoltaic technologies that generate electricity.

As the studio itself declares, Ombù is one of Foster+Partners' most sustainable projects and has already become, despite its short existence, a virtuous case study for the World Green Building Council. To the benefit of project initiatives for reusing existing buildings, as an alternative to the desire to produce new volumes where not strictly necessary, the London-based studio estimated that the Ombù project is capable of reducing carbon production by 25% compared to a new construction for the entire duration of the project, also taking into account future renovations. Additionally, it has been revealed that operational energy is actually 35% lower than normal expectations [1].

Voids are resources for the culture of Architecture design and for the protection of the environment

As often happens with great works, Ombù holds not only the value of being a prestigious piece of architecture but also the significance of generating a new awareness towards methods of reusing abandoned buildings. Foster+Partners' project, by bringing back to life a disused building, ensures the recovery of the area in which it stands, reactivates the involvement of the local community, and ultimately establishes a new paradigm for sustainable urban development. In this way, Ombù sets a model for an interpretation of architectural design that will increasingly appear necessary for the cities of the future.

Along this path of development and taking renowned experiences like those conducted by the London-based studio as a model, Architecture Schools can also propose and experiment with the exploration of innovative concepts and approaches for the revitalization of disused industrial heritage. Within universities, educators guide students through interdisciplinary collaboration and research-driven inquiry to develop new visions for adaptive reuse and regeneration of abandoned sites, aiming to provide a sustainable future for the historical heritage of cities.

Moreover, architecture schools serve as a connection point between the academic world and the professional realm, offering students the opportunity to directly engage with real-world issues and stakeholders. Through internships, workshops, and community partnerships, future architects gain practical experience and delve into the complexities of a design-sensitive topic such as the regeneration of disused sites, learning to navigate the political, economic, and social dynamics that are essential aspects of industrial sites redevelopment.

This cultural horizon tied to the project of disused heritage also aims to foster a new sense of responsibility and ethical management in the new generation of architects, promoting attention to principles of sustainability, resilience, and social equity.

This design approach is even more significant when observed from the perspective of Mediterranean areas, where the legacy of industrialization intersects with the rich cultural heritage of the region and its diverse economic landscapes. In these areas, the adaptive reuse of disused buildings takes on additional significance: the Mediterranean basin has always been characterized by the presence of port cities, as well as vast inland areas with abundant resources that have historically generated substantial industrial dynamics. However, changes in economic dynamics, evolving industries, and ongoing transformations in industrial management policies have emptied places that for decades were symbols of productivity, economic progress, and urban and social development. This has not only left these big architectures to their solitary fate but also left communities grappling with unemployment and the urban decay that has inevitably enveloped these abandoned places.

In this context of economic transition and the need to develop a new environmental sensitivity in the field of architectural design, the reuse of abandoned industrial buildings emerges as a promise of a new development model for Mediterranean areas.

As already happened in some Mediterranean cities, repurposing these structures for new uses, such as artisan workshops, professional studios, cultural venues, or as in the case of Foster+Partners' project, offices

for private companies that look towards collective development, allows the Mediterranean region to draw upon its rich cultural heritage and millennia-old entrepreneurial spirit to create new opportunities for employment and economic growth. This contributes to broader goals of sustainable development and environmental conservation by minimizing the environmental impact of urban development and promoting efficient use of resources.
Finally, the revitalization of industrial sites can breathe new life into neglected urban neighborhoods, fostering social cohesion and the reconstruction of a collective identity for the places where communities can continue to recognize themselves.

Notes
[1] https://www.fosterandpartners.com/projects/ombu> (accessed 12 May 2024).

References
Casamonti, M. (2022). Industrial Reuse: Introduction. In *Area. Rivista internazionale di architettura e arti del progetto*, No. 184, p. 2.

Urban Agenda for the UE (2019). *Sustainable & Circular re-use of Spaces & Buildings Handbook*, p. 12. <https://ec.europa.eu/futurium/en/circular-economy/handbook-sustainable-and-circular-re-use-spaces-and-buildings.html> (accessed 12 May 2024).

The regenerative potential of Point of Interest (POIs) in urban renewal: the Pietrarsa Railway Museum for the coast of San Giovanni a Teduccio

Massimiliano Campi

Urban regeneration is a crucial theme for many Italian cities, especially those with a rich historical and cultural heritage like Naples. Among various redevelopment projects, the renewed Pietrarsa Railway Museum stands as a significant example of the transformative potential that historical and cultural landmarks can have on the surrounding urban fabric, particularly for the coast of San Giovanni a Teduccio.

Urban regeneration involves the revitalization of urban areas that have experienced decline, aiming to improve the physical, economic, and social aspects of the environment. In new planning methodologies to try to rehabilitate this kind of areas, Points of Interest (POIs) play a critical role in this process, acting as catalysts for economic growth, community engagement, and cultural development.

A Point of Interest (POI) in the context of urban planning and development refers to a specific location within a city that attracts people due to its cultural, historical, recreational, or aesthetic value. POIs can range from museums, parks, and historical landmarks to entertainment venues, shopping districts, and public art installations. These sites play a pivotal role in defining the character and appeal of urban areas. Urban regeneration involves revitalizing parts of a city that have fallen into decline, with the goal of improving physical, economic, and social conditions. POIs are essential in this process for several reasons.

The eastern coast of Naples, particularly the areas encompassing San Giovanni a Teduccio, Barra, and Ponticelli, has faced a range of urbanistic

Fig. 1. 'Museo Nazionale Ferroviario di Pietrarsa', panoramic view (source: https://www.ferrovie.it/portale/articoli/15060).

problems over the years. These challenges are a result of historical industrialization, socio-economic disparities, environmental degradation, and inadequate infrastructure. This part of the territory was historically an industrial hub with factories, refineries, and shipyards. The decline of these industries has left behind numerous abandoned and contaminated sites, known as brownfields. These industrial sites have contributed to significant soil, air, and water pollution, posing health risks to local residents and hindering redevelopment efforts.
The decline of traditional productions has resulted in high unemployment rates, particularly among the youth. This economic hardship has exacerbated social problems such as poverty, crime, and educational underachievement. The area has suffered from a lack of public and private investment, leading to deteriorating infrastructure, inadequate public services, and poor housing conditions.
Despite some improvements, the eastern coast still struggles with inadequate public transportation options. This limits mobility for residents and restricts economic opportunities. Roads, bridges, and public facilities are often in poor condition, requiring substantial investment for repairs and modernization. Many residential and commercial buildings in this area are in a state of disrepair. The lack of maintenance and investment has led to unsafe living conditions and unattractive urban landscapes. As consequence of years of decay there are numerous vacant

Fig. 2. 'Museo Nazionale Ferroviario di Pietrarsa', aerial view, detail (source: https://cefisrl.it/pietrarsa/).

and abandoned properties that contribute to urban blight and discourage new development.

The eastern districts often feel disconnected from the economic and cultural life of central Naples. This social isolation is reinforced by physical barriers such as railways and industrial zones. The lack of community spaces and cultural amenities further isolates residents, reducing opportunities for social interaction and community-building. Socio-economic difficulties have contributed to higher crime rates in the eastern coast areas of Naples. This includes both petty crime and organized crime, which can deter investment and development. Residents often face safety concerns related to both crime and the physical condition of their environment, including unsafe buildings and poorly lit streets. POIs can often embody the historical and cultural essence of a community. They provide a sense of identity and pride for residents, fostering a connection to their city's heritage. This sense of pride can inspire community involvement in preservation and enhancement efforts, contributing to the overall success of urban regeneration projects. These peculiar places contribute to the cultural identity of a city, or a part of it, preserving its history and traditions while also promoting contemporary cultural expression. They help build a unique character for urban areas, making them more attractive and livable.

There are many case histories in the world that demonstrate how the recovery of the pride of identity of a site was the cooperative engine for starting and promoting effective regeneration processes, as in the case of some neighborhoods in New York or - to cite examples that are better known and experienced by the author - the city Barcelona, which was able to exploit events of global importance such as the 1993 Olympic Games, to give a new life to the entire city, with a recovery that has not stopped and which has made the Spanish city one of the most admired cities in Europe.

The Role of Points of Interest (POIs) in Urban Regeneration and Pietrarsa Museum as epicenter of a new potential renewal

POIs play a significant role in revitalizing urban areas by driving tourism, generating revenue, creating jobs, and fostering social and cultural benefits. Here's how they contribute in terms of Tourism and Revenue Generation. In fact, Points of Interest such as museums, historical sites, parks, and entertainment venues are key attractions for tourists. Their presence leads to an increase in visitors, which in turn boosts the local economy. Tourists spend money in local businesses like restaurants, shops, and hotels, bringing in much-needed revenue. This influx of money can be reinvested into urban improvements, sparking a positive cycle of development and growth within the city.

Furthermore, the establishment and upkeep of POIs can generate a wide range of employment opportunities. Sectors such as construction, hospitality, retail, and transportation benefit directly from the development of these sites. Additionally, the ongoing operations of POIs require staff for roles in administration, marketing, and daily management, providing long-term job prospects for residents. This not only supports the economy but also helps reduce unemployment in the community.