PROTECTING AND REDEVELOPING INDUSTRIAL ARCHAEOLOGICAL HERITAGE THROUGH DESIGN STRATEGIES DRIVEN BY DIGITAL MODELLING

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1. Introduction: contextualizing territorial constraints and industrial archaeology

The Municipality of Tivoli, owner of the building, has promoted a design competition with the idea of turning what is now an industrial ruin of considerable negative perceptual-functional impact for the city into an important and strategic opportunity for urban transformation. The former Amicucci-Parmegiani paper mill represents a dross space, an urban void, so defined not just because of its dilapidated, neglected and deteriorated condition, but because it has lost its original functional vitality within the context, its meaning within the city fabric, consequently becoming a typical greyfield.

The objective of renewing the area occupied by the building is to revamp a process of urban regeneration through the improvement of aspects such as the architectural perception of the context, especially through the redesigning of the downstream elevation, increasing its attractiveness for the city centre, its mobility, the environment and integration with the surrounding landscape, improving social and economic relations, infrastructures and interaction by creating new common spaces that connect with the urban fabric. The area is characterised by a notable landscape, given its location close to the historical centre (Figure 1) and important landmarks such as the Duomo to the south and the valley formed by the course of the Aniene river, the waterfalls, the church of S.M. di Quintiliolo on the opposite slope to the north, and the Sanctuary of Hercules Vincitor. Historically, before the settlement of industrial activities, the area was characterised by a visual and direct connection between the building fabric and relevant naturalistic landscape with the presence of cultivated terraces, in particular, used for the production of the typical Pizzutello Tiburtino[1]. In our collective imagination, the city of Tivoli is strongly linked to the presence of important historical sites, such as Villa Adriana and Villa D'Este. Tivoli, however, has an industrial soul. From the beginning of the 20th century, thanks to the special exploitation of the waters of the Aniene and through a system of underground canals, numerous mills of different kinds, including paper, of course and other factories, flourished. Thanks to this natural local feature and industrial development, it was here that the development and use of hydroelectric energy was

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born and it was Tivoli itself that was the first town to benefit from electric light produced by hydraulic motors in 1886 [1].

a) b)

Figure 1. a) City plan of Tivoli showing position of the paper mill (highlighted in red); b) the building in its urban context (perimeter highlighted in red).

The area on which the industrial plants and artisan workshops were located was close to the medieval part of the town, in the area known as 'del Colle' (Figure 2), adjacent to and, on some occasions, integrated into the fabric of the historic centre.

Figure 2. Panorama of Tivoli on the outskirts of Rome with the Roman countryside. On the right, the area known as 'del Colle', Brogi 1900-1910 ca (Source: Archivi Alinari, Florence).

The relationship between the buildings used for production activities, the city and the residences of the occupants in the sector, was quite peculiar in Tivoli: alongside the

industrial development there were no workers' districts, despite the fact that in 1941 there were more than 7,000 workers[2]. This immediately highlights how the phenomenon of urbanisation, typical of the Industrial Revolution period, which caused 'the evils' of many cities, did not occur here.

The reasons for this positive development are linked, on the one hand, to a gradual process of growth over time, in which the search for spaces and functions took place within old buildings and, in some cases, also through the reuse of pre-existing archaeological sites; secondly, it was the historic centre itself that represented the residential district of reference, thus generating a balance between home and workplace, between living and working. However, since the paper mills and other industrial plants have closed, there has been a slow emigration of inhabitants from the medieval district.

In the old industrial area of Tivoli, therefore, important remains of the classical age coexist with paper mills, factories and related infrastructure such as, in particular, the canals. These heterogeneous elements, layering one on top of the other, make it difficult to recognise the historical character of each individual part. The case of the former area of the Segrè paper mill is exemplary [2], embracing a time span of more than 2000 years: from the Sanctuary of Hercules the Victor to the 15th-century convent, the powder warehouse and the 18th-19th-century ironworks, up to the transformation realized until the mid-20th century.

2. Origins, development, and abandonment: The industrial system along the Aniene Valley

Generally speaking, during the process of industrialization that characterised the economic and productive evolution of the pre-unification of Italy, paper production played a leading role [3]. Between the 15th and 16th centuries, there was already evidence of ancient paper mills throughout the region, such as those in Grottaferrata, Sant'Elia Fiumerapido, Carnello, Tivoli and Subiaco, the first three of which were, not surprisingly, abbey paper mills. In the same places, factories were set up which, in some cases, would see production activities consolidate and expand over time until the establishment of flourishing industrial basins.

Finally, the 1820s saw the industrialisation of production in the Terra di Lavoro in the Kingdom of Naples, today's Lower Lazio region, based on a long artisan and proto-industrial tradition and in exceptional synchrony with similar experiences in France and England, which in a short time transformed production into a continuous mechanical process [4]. However, the paper mills mentioned above, although in very close proximity to each other, do not belong to historically homogeneous areas. We will focus, for the purposes of this project, on those of Tivoli. Presenting an overall picture of the Tiburtine paper mills is not easy, as they are numerous and mentioned in various sources with references that are not always in agreement.

The paper mills initially drew impetus and benefited from the network of pipelines that had already been dug under the city in Roman times, as well as from the waterfall of the Aniene, also known in the past as the Teverone. From the 16th century onwards, this network became more complex and vast, heralding the remarkable hydraulic constructions of the 19th century and the exploitation of energy production of the 20th century. This was the era of mechanized paper making: the hydraulically operated pestle mallet was introduced by the masters of Fabriano and was associated with the pulp pile [5]. There are many testimonies attesting to the production of paper in Tivoli as early as the 15th century, and which also report some proprietary events linked to the presence of many piles. It is still possible, on the side of Tivoli that looks towards Via del Colle, to

recognise environments and signs of this proliferation of activity. This settlement, located within the urban fabric of the city, was a crucial place of craft activities that characterised one of the most flourishing productions of the time. The description by Tommaso Neri (De Tyburtini aeris Salubritate Commentarius of 1622) with the accompanying plan, later taken up by Stoopendaal many decades later, emphasizes precisely this aspect of the city. We would say today a 'city of water' in which a dense web of canals is interwoven with the bends and twists in the road network and the fabric of the residential and artisan buildings (Figure 3).

Figure 3. Peter Vander Aa (dis.) D. Stoopendaal (Inc.) Civitatis Tyburis Delineatio, 1721-1750, from the plan by Tommaso Neri,1622.

The second most widespread innovation in pre-industrial production is the 'stack' or Hollander beater (1670), or 'stack with cylinder'. It replaced the use of pestles to prepare the paper pulp. Although it was invented in the 17th century, it only became more widespread, in Italy in general and in Tivoli in particular, in the 19th century. The 'Dutchman' consists of an oval stone or masonry basin divided into two parts by a median septum, so as to form two communicating channels. One of the two channels is wider and is called a working channel. There was a wooden cylinder, later made of metal, fitted with blades. The bottom of the sloping channel was also equipped with blades held together by screws and separated by wooden rods and was called 'platen'. The Hollander beater became a success also because of its versatility because with the appropriate modifications it could be used for various purposes. However, it is undeniable that Roman and Tiburtine paper mills at the beginning of the 19th century were technologically behind and mainly specialised in cardboard, wrapping paper and other types of paper rather than in the production of printing paper. Later, in paper mills with long histories,

such as Ranzi[3], there are special areas defined over a long period of time for grinding wheels, kettles and Dutch stacks. In 1883, the Ranzi paper mill had 10 Dutch cylinders and the production system was organised for the manufacture of different types of paper, cardboard and wrapping paper. Rolls were used to defibrate and pound straw. From the end of the 19th century, and with the impetus of hydroelectric power generation, industrial production took off.

3. The collapse: implications and consequences

The area of study is located[4] on the edge of a subsiding basin at the foot of the first Apennine reliefs of Latium, in a zone where the proximity of the volcanic complex of the Alban Hills (Colli Albani in Italian) has favoured the development of hydrothermal upwelling events which have contributed to the formation of travertine deposits. The historic centre of Tivoli stands on a travertinoid formation resting on fluvio-lacustrine sequences, volcanic products and Pleistocene Pliocene marine soils, in turn resting on Meso-Cenozoic terms that form outcrops on the outline of the area. Sheet 375 [6] of Tivoli of the New Geological Map of Italy (CARG project, scale 1:50,000) indicates the travertine deposits (TBT_b[5]), outcroppings in the area of the former paper mill, whose structures rest on very porous, stratified and fractured travertine deposits, generally cemented and only locally altered in the form of travertinoid sandstone. Morphologically, the former paper mill is located on a sub-flat area on the edge of a slope that connects the summit elevations of approximately 200 m a.s.l. with the valley floor elevations of approximately 70 m a.s.l. The slope has a very high gradient, generally between 80° and 90°, and consists of two sub-vertical slopes interrupted in the middle by a terrace of a few metres wide, on which the roadway of 'Via degli Stabilimenti', currently partly in disuse, is located. On 9 April 2009, a portion of the former paper mill was involved in a massive collapse, immediately falling down onto 'Via degli Stabilimenti' that runs through a tunnel (Figure 4).

Figure 4. Present day situation (2020): result of the massive collapse of 2009 on a section of road, "Via degli Stabilimenti", that runs through a tunnel (Source: Municipality of Tivoli).

The collapse was probably induced by the sequence of aftershocks of the L'Aquila earthquake. In particular, one event occurred at 00:52:59 with a peak acceleration registered at Poggio Cancelli of approximately 0.3g [7]. It is not easy to determine the sequence of the collapse precisely, consequently what is visible in Figure 4 could have been induced either by a first collapse of the structural element which successively involved the soil foundation or viceversa. At present, the slope is affected by at least two escarpments listed among the active landslide escarpments by the hydrogeological management plan chart of the Central Apennine basins (formerly the Tiber basin).

Examination of the available data reveals a generally critical situation with regard to the stability of the slopes on the edge of the former paper mill structures. The proposed project was set up with a view to mitigating and alleviating the unstable conditions of the slopes as much as possible by providing escarpments for:

- The removal of some sections of the former paper mill structures which will lead to a reduction in the weight bearing on the top of the wall;
- Sub-founding and consolidation work at the portion of the car park that is to be built in correspondence with the sector of the slope affected by the 2009 collapse;
- Slope cleaning operations with the removal of any unstable blocks so as to guarantee the possibility of carrying out the geostructural surveys that are indispensable for the definition of the slope safety project.

With regard to the demolition of part of the structures of the former paper mill and given the considerations on the static condition of the building (Figure 5) the following aspects were assessed in order to optimise demolition.

Figure 5. Image from the outer courtyard of the paper mill, taken at elevation relative to the direct connection with the city of Tivoli (208 meters a.s.l.), towards the opposite slope, where the complex of the Sanctuary of Maria SS. del Quintiliolo stands (Source: Carlo Vannini).

- Reconnect with the historic centre, obtain an extension of Piazza Tani and recover full enjoyment of the admirable and evocative sights (Figure 6);
- Highlight historical and cultural aspects of relevance related to industrial archaeology (Figure7), such as the processing chain of the former paper mill;
- Enhance the relationship with the landscape, which is of great scenic value due to the view of the valley below and the opening to the countryside (Figure 8).

Figure 6. Image from the outer courtyard of the paper mill, taken at elevation relative to the direct connection with the city of Tivoli (208 meters a.s.l.), towards the bell tower on Domenico Tani square (Source: Carlo Vannini).

Figure 7. Image taken at elevation of the boilers area (204 meters a.s.l.) (Source: Carlo Vannini).

Figure 8. Image taken on the floor at 199 meters asl: that is the view from the facade facing the Aniene valley, towards the complex of the Sanctuary of Maria SS. Del Quintiliolo, on the right (Source: Carlo Vannini).

4. Tools for understanding and valorizing industrial heritage

Technical advances in architectural and structural surveying provide valuable tools to optimise time and reduce errors and approximations, typical of traditional methods. These tools allow professionals to achieve a high degree of knowledge of the object that is to be studied and represented and on which they will subsequently have to intervene [8].

Today, technology has gone beyond the typical aerophotogrammetric survey from which modern cartography was born by polishing orthophotos. Systems have advanced from a two-dimensional to a three-dimensional reading. First, through the superposition of orthophotos with DTMs (Digital Terrain Models) and later, at the beginning of this century, laser survey systems were introduced, LIDAR (Laser Imaging Detection and Ranging), positioned on planes and helicopters and nowadays positioned also on drones.

The most significant development concerns software that uses photogrammetry to reconstruct three-dimensional meshes. Laser-scanning equipment, which was previously very large and expensive, has become increasingly compact and accessible over time and, as a result, its use is widespread.

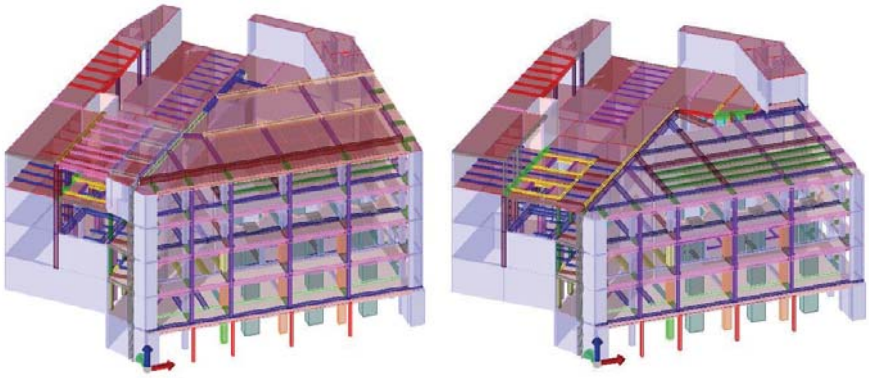
At the same time, there is a tendency to limit new construction and enhance the existing heritage. With this in mind, technological advances in automatic surveying and diagnostic instrumentation make it possible to operate with greater knowledge and thus to produce higher quality interventions on the built environment. The data collected by laser and photographic equipment is transformed into a point cloud (Figure 9): that is,

a set of data points in a three-dimensional space, each characterised by spatial coordinates (x, y, z) indicating its position in space and any relevant values, such as colour intensity or depth [9]. These new points are models made up of images, which, once imported into three-dimensional modelling or BIM programmes, can be polished in a more or less automated manner depending on the type of software being used. Designers thus find themselves being able to work on high-definition models that, together with a direct knowledge of the building object, allow them to be aware of all the geometric, qualitative and material information that form the basis of a recovery operation. From this photogrammetric model, by means of parametric modelling in the BIM sphere, it is possible to create a digital reproduction which is completely superimposable on reality. The parametric model developed in BIM starting from the polishing of the new point cloud, is a complex process that consists of sectioning the point cloud at different heights, which is indispensable for organising the digital work environment, setting the reference planes and then polishing the building texture in plan and elevation. The digital model was elaborated from the point cloud obtained in the survey campaign carried out by laser scanner, which provided dimensional and qualitative information that also helped describe the state of material degradation.

Figure 9. Final point cloud of the paper mill (Source: Antonio Landa).

Other equipment such as thermal imaging cameras and carpenter's hammers allow us to learn about the type of masonry, the crack pattern, the presence of hidden structures; they can also aid in identifying thermal anomalies and moisture content in the masonry which can be related to variations in mass [10,11]. Structural testing campaigns carried out by means of common techniques such as cores, jacks and extractions are still indispensable for working on load-bearing structures and they can be eventually enriched by other non-invasive technologies such as gamma tomography, x-rays and neutronic analysis. Taken together, these operations make it possible to obtain, by combining all the data collected, bimodal, parameterised digital models containing all the information, from geographical to spatial, structural, plant, material and qualitative. The complexity of the models thus created condenses all the information within a single digital object that becomes a twin of the real one [12]. Thus, the integral approach to design has consisted in the continuous interchange of data between architects, structural engineers and plant engineers. From these models developed in BIM with different software it is possible to extrapolate interchangeable copies in different

formats, which can be read by different specialised programmes to make calculations on structures, plants and, clearly, for architectural design. Thus, the work is organised through a continuous flow of interchange. This is segmented into the different specialised areas and then reconnected within a 'mother' file that encapsulates all the information. The interoperability between BIM models and FEM models (Figure 10a) have permitted the structural design project to be developed step-by-step with the evolution of architectural projects and optimizing economic resources to obtain better safety enhancement for both static and dynamic loads provoked by the expected earthquake for the area. Comparing the structural models, it appears clear that in the post-operam configuration the main building loses the top floor (Figure 10b).



a) b)

Figure 10. Structural Finite Element Model: a) ante-operam; b) post-operam (Source: Vincenzo Gattulli).

Systems are being developed, also through the use of artificial intelligence, that allow parametric modelling to be automated from new point clouds, but there is still a long way to go. The data must still undergo a critical reading and have direct knowledge of the objects to be digitally reproduced. Perhaps over time the work will be greatly simplified, but eliminating human contribution won't happen soon, as it is an essential part in the interpretation of the data and the coordination of the interferences generated in such complex and heterogeneous workflows.

The experience of the redevelopment project and adaptive reuse of the former Amicucci Parmegiani paper mill in Tivoli as a museum, is an example of this process.

Specifically, the laser scanner survey campaign, conducted on 20 March 2023, was carried out with Leica's 'Cyclone REGISTER 360 (BLK Edition)' equipment.

The quality of the recording can be summarized through the following parameters:

- Set Up count: 103;
- Link count :140;
- Robustness 74%;
- Overlap 43%.

The polishing of the point cloud and the creation of the Bim model was mainly developed through Autodesk's Revit platform.

5. Collaboration with the supervisory authority: Towards transformation

The building in question is a portion of the former paper mill complex, overlooking the valley through which the Aniene River flows. It has been decommissioned and is in a completely empty and dilapidated state. It has a main entrance on the north side of Piazza Tani and one from 'Via degli Stabilimenti'. The factory, consisting of five levels, has a maximum height of 30 meters on the north elevation and a linear development of about 160 meters. The surface area of the interior spaces of the current building is approximately 20,000 square meters, giving a total volume of approximately 92,000 cubic meters; there are also a series of external spaces, adjacent and functionally connected to the Paper Mill: the total area of the latter, included within the perimeter of the Amicucci-Parmegiani complex, is approximately 2,400 square meters. The calculated surface area includes the central portion of the building that has been in a state of collapse since 2009. As a result of the collapse, which also involved the underlying gallery and 'Via degli Stabilimenti', the area was at risk, thus interventions were required to secure the slope affected by the collapse.

The choices made in the final design confirm and deepen the criteria and strategies made during the preliminary elaboration phase by the Municipality of Tivoli. Given that the building is a listed one, during meetings with the municipal administration's technicians and at the meeting with the 'Soprintendenza Archeologia, Belle Arti e Paesaggio per l'area metropolitana di Roma, la Provincia di Viterbo e l'Etruria meridionale', the general objectives of the project proposal were illustrated for the redevelopment and valorisation of the building block of the former Amicucci Parmegiani Paper Mill. Through the meetings with the technicians of the office deputed to the protection and valorization of the listed building complex, the main design concept was defined and shared, adopting the following guidelines.

- The mandatory guidelines of transformation and protection indicated in the historical-artistic report attached to the Decree[6] of constraint of historical-artistic interest pursuant to Article 12 paragraph 2 of Legislative Decree 42/2004 applied to the building complex (Figure 11);

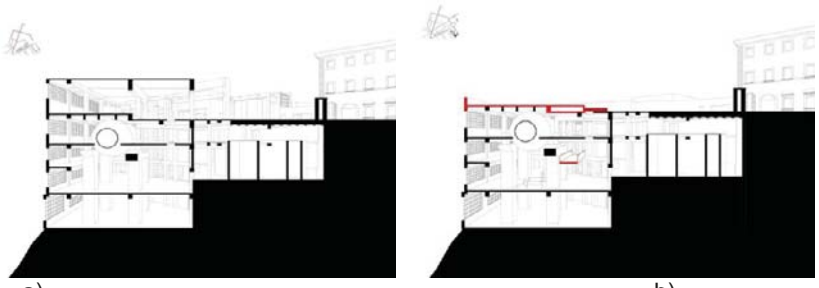


Figure 11. Perspective sections from the BIM software: a) ante-operam, b) post-operam. (Source: Antonio Landa and Carlo Vannini).

- The general criteria set forth in the design guidelines document[7] of the Design Competition for the construction of the auditorium and car park in the area of

the former Amicucci Parmegiani paper mill and the principles of the general proposal of the winning project.

The general objectives of the design competition, beyond the programme of uses and the definition of the perimeter of the areas to be demolished with respect to the portions to be conserved, paid particular attention to the relationship (Figure 12) of the complex with the landscape, in relation to the view from and towards the valley, with the complex of the Sanctuary of Hercules the Victor, and in relation to the opposite slope, where the complex of the Sanctuary of Maria SS. Del Quintiliolo stands.

Figure 12. Perspective view on the new square (199 meters a.s.l. elevation) from the paper mill towards the complex of the Sanctuary of Maria SS. Del Quintiliolo (Source: Antonio Landa).

6. Future perspectives: Leveraging digital technologies for sustainable development

In envisioning the future of industrial heritage sites, it is imperative to adopt a comprehensive and forward-thinking approach. This chapter explores the multifaceted strategies and considerations involved in revitalizing these sites, drawing upon insights from stakeholder consultations, expert interviews, and scenario planning exercises. The future of industrial heritage sites is not predetermined but can be shaped through careful planning and foresight. Scenario planning exercises allow us to explore a range of possibilities, from adaptive reuse to innovative redevelopment schemes [13]. By anticipating various trajectories, we can develop resilient strategies that adapt to changing societal needs and economic trends. Digital technologies offer unprecedented opportunities for preserving and presenting industrial heritage in engaging and immersive ways. Through the creation of digital archives, virtual reality experiences, and interactive exhibits, we can bring the stories of these sites to life for present and future generations. Augmented reality apps can overlay historical information onto physical spaces, creating dynamic educational experiences for visitors. For example, virtual tours related to

the history of the building can show the changes in papermaking techniques through the centuries. The virtual tour could indeed incorporate some traditional elements of tours and lectures, such as images of artefacts and photographs, but also include videos illustrating different papermaking methods. Papermaking, for example, becomes much more understandable when the exhibited artefacts can be seen in action. A virtual tour encourages the public to spend more time examining the artefacts of industrial archaeology and learning about their history.

Central to the revitalization process is the active involvement of local communities. Community engagement strategies go beyond mere consultation, seeking to empower residents as active participants in decision-making processes. Advisory committees, public workshops, and community events foster a sense of ownership and stewardship, ensuring that revitalization efforts reflect the diverse needs and aspirations of the community. Sustainability lies at the heart of our approach to revitalizing industrial heritage sites. By integrating sustainable development principles into our plans, we can minimize environmental impact and maximize social and economic benefits. This includes the adoption of green building practices, the promotion of renewable energy sources, and the prioritization of local sourcing to support the circular economy. Revitalizing industrial heritage sites presents an opportunity to drive inclusive economic growth that benefits all members of the community [14]. Job training programs, support for local businesses, and equitable development incentives ensure that the benefits of revitalization are widely shared. Revenue-sharing agreements and community benefit agreements can further promote economic equity and social cohesion. A successful revitalization effort requires collaboration across disciplines and active participation from stakeholders at every stage. By harnessing the expertise of urban planners, architects, historians, economists, and community organizers, we can develop holistic and sustainable solutions. A participatory approach ensures that diverse perspectives are heard and valued, leading to more informed decision-making and greater community buy-in. In conclusion, revitalizing industrial heritage sites demands a holistic approach that integrates digital innovation, community engagement, sustainability, and economic inclusivity. By embracing this approach, we can breathe new life into these sites while preserving their cultural significance and promoting inclusive and sustainable development for the benefit of present and future generations.

7. Conclusion: Charting a path forward

In conclusion, this article underscores the profound impact of digital models in the preservation, comprehension, and reimagining of industrial archaeology heritage. Through a comprehensive synthesis of the insights gleaned from the preceding sections, we reaffirm the paramount significance of collaborative partnerships, technological advancements, and sustainable development principles in the protection and promotion of our collective cultural legacy for generations to come.

By amalgamating the knowledge distilled from our exploration, we emphasize the critical role of collaborative efforts between stakeholders, including academic institutions, governmental bodies, private enterprises, and local communities. These partnerships serve as the bedrock for the successful implementation of innovative solutions aimed at safeguarding industrial heritage sites. Moreover, we highlight the indispensable contribution of technological innovation in the documentation, interpretation, and dissemination of industrial archaeology. Digital models serve as dynamic repositories of historical information, offering unprecedented opportunities for immersive exploration and interactive learning experiences. By harnessing emerging technologies such as

virtual reality, augmented reality, and 3D scanning, we unlock new dimensions of understanding and appreciation for our industrial past. In tandem with technological innovation, we advocate the integration of sustainable development principles into heritage conservation practices. Embracing principles of environmental stewardship, economic viability, and social inclusivity, we strive to ensure the longevity and relevance of industrial heritage sites in a rapidly changing world. As we chart a course forward, we envision a future that embraces adaptive reuse, cultural tourism initiatives, and community-driven empowerment strategies. By leveraging the inherent resilience and cultural capital of sites like the former Cartiera Amicucci Parmegiani, we aspire to foster vibrant ecosystems where heritage preservation coexists harmoniously with economic revitalization and social cohesion. In essence, our collective endeavor is not merely to preserve relics of the past but to breathe new life into them, transforming industrial heritage sites into catalysts for sustainable development and cultural enrichment. Through unwavering dedication, ingenuity, and a shared commitment to our cultural heritage, we pave the way for a more resilient and inclusive future, one where the echoes of the past resonate vibrantly in the tapestry of our collective identity.

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Notes

[1] The Pizzutello Tiburtino is an ancient variety of table grape cultivated mainly in the area of Tivoli, where it has been grown for centuries. This variety is prized for its characteristic, elongated fruits, hence the name 'pizzutello', which in Italian means 'little peak' or 'little point'. It is considered a high-quality product and is often found in local markets and food fairs in the region. This variety is particularly renowned for its quality and for the role it plays in the agricultural culture and tradition of the Tivoli area.

[2] From the "Design Competition rules and regulations" of the "Open design competition for the construction of the auditorium and parking lot in the area of the former Amicucci Parmegiani paper mill.

[3] Ranzi-Sibilla was one of the first three paper mills to produce ordinary paper called waste paper. It was built in 1847 near the San Martino steps in Tivoli. It is currently in disuse but is in a fairly good state of preservation. It too is part of the industrial archaeological heritage of the city of Tivoli, and like the Amicucci-Parmegiani paper mill, is located near the historic centre and not far from the factory that is the subject of this article.

[4] From the chapter "Geological framework", of the General Project Report (BEST Design, Sapienza startup) for the recovery, refunctionalisation and musealisation of the

building block of the former Amicucci-Parmegiani Paper Mill in the Municipality of Tivoli.

[5] Vacuolar travertine, Travertine deposits from thermal waters, porous and more or less friable, whitish, yellowish or reddish in colour, with horizontal, often indistinct stratification. Outcrops of lithoid travertine deposits in the Bagni di Tivoli area. Shallow lacustrine environment. Variable thickness, between 5 and 10m.

[6] Extract of the constraint of historical-artistic interest placed on the building complex by Ministerial Decree no. 104 of 30/07/2020:

"As can be read in the excerpt, the part of the complex located above a height significant for landscape perception and the most recent portion of the building, built in front of the ancient complex of the Convent of St. Catherine, are excluded from the constraint."

"[...]In the part of the complex to the west, accessible from the square facing Piazza Tani:

- *The part identified by red shading in the drawings on the various levels, which preserves legibly the chain of workings in its vertical development, is subject to protection:*
- *The part of the building set at the height of Piazza Domenico Tani (elevation +208) is not subject to protection - due to the poor architectural quality, the degraded state of the structures (mostly cement), and not preserving significant elements of the chain of workings - in order to restore the view towards the picturesque river valley below; and the Quintiliolo hill, which has always constituted, until before the raising of the paper mill, the main attraction of the square itself."*
- *"[...] Of the remaining part of the industrial complex, located to the east and of the forecourt towards Piazza Tani:*
- *The buildings are not subject to protection, as they are post-1950 and of no historical, architectural or cultural interest.*

All demolitions shall be carried out with due caution so as not to cause damage to adjacent parts and with the involvement of an archaeologist for the part at the lower level."

[7] Extract from the 'Design Competition for the construction of the auditorium and car park in the area of the former Amicucci Parmegiani paper mill', Municipality of Tivoli, 2020: *"[...] The current building, with its massive out-of-scale volume of the former paper mill, obscures the Tower of Santa Caterina located in the western area of the complex, which represents a distinctive architectural and geometric sign, not only of the immediate context, but of the entire skyline of Tivoli's historic centre. The tower, in addition to requiring urgent consolidation works, constitutes an element with which every design intervention will have to integrate and relate."*

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Summary

The former Amicucci-Parmegiani paper mill is a publicly owned building in the historic center of Tivoli: long abandoned and dilapidated, it has recently been the subject of a design competition for its recovery. It is part of a wide system of old industrial paper mill settlements located along the Aniene river, due to the availability of water; nowadays, they are abandoned and testify to the stratification of a productive activity in a place that has been inhabited since Roman antiquity. The strategy regarding the aim to create a new approach to the old - the case study was developed through the activity of a Sapienza Startup - is a notable example of a new approach to renewing, repairing and rebuilding the built modern heritage. With dwindling resources, it has become necessary to listen to and work with the history of the buildings rather than demolish them. Guided by these principles, an integrated strategy of conservative intervention has been studied to preserve the industrial identity of the building, enhancing its productive characteristics with a functional programme that involves the citizenship and tells the story of the Paper Mill and its industrial processes through a museum, triggering a virtuous cycle of growth, development and landscape restoration. A landscape belonging to a current drosscape has the opportunity to push the renovation of a piece of city. Demolition of the existing heritage is triggered by the opportunity to initiate processes of economic valorisation: the case of the former paper mill is a unique one since the right to demolish - sanctioned by the constraint placed on the area and the building - aims at constructing, through complex demolition work and a little reconstruction work, the common value of a "new urban landscape", in an area of extraordinary quality. Within a framework of shrinking public resources, the value of recovering the existing heritage - specifically a fragment of industrial archaeology - represents an opportunity to validate choosing conservation over the hypothesis of building replacement, with respect to social, environmental and economic variables.

Riassunto

L'ex cartiera Amicucci-Parmegiani è un edificio di proprietà pubblica nel centro storico di Tivoli: da tempo abbandonato e fatiscente, è stato recentemente oggetto di un concorso di progettazione per il suo recupero. Appartiene a un ampio sistema di precedenti insediamenti industriali di cartiere situati lungo il fiume Aniene, per la disponibilità di acqua; oggi sono abbandonati e testimoniano la stratificazione di un'attività produttiva in un luogo abitato fin dall'antichità romana. La strategia relativa all'obiettivo di

sviluppare un nuovo approccio all'antico – il caso di studio, sviluppato attraverso un'attività di una startup della Sapienza – è un esempio notevole di un nuovo approccio al rinnovamento, alla riparazione e alla ricostruzione del patrimonio costruito moderno. Con la diminuzione delle risorse, è diventato necessario ascoltare e lavorare con la storia degli edifici piuttosto che demolirli. Sulla base di questi principi, è stata studiata una strategia integrata di intervento conservativo per preservare l'identità industriale dell'edificio, valorizzando le caratteristiche produttive con un programma funzionale che coinvolge la cittadinanza e racconta la storia della Cartiera e dei suoi processi industriali attraverso un museo, innescando un ciclo virtuoso di crescita, sviluppo e restauro del paesaggio. Un paesaggio appartenente a un attuale 'drosscape' ha l'opportunità di spingere un rinnovamento di un pezzo di città. Le azioni di demolizione del patrimonio esistente sono innescate dall'opportunità di avviare processi di valorizzazione economica: il caso dell'ex cartiera rappresenta un unicum, poiché la facoltà di demolizione - sancita dal vincolo posto sull'area e sull'edificio - ha l'obiettivo di costruire, attraverso un'azione complessa di demolizione e una ridotta attività di ricostruzione, il valore comune di un "nuovo paesaggio urbano", in un'area di straordinaria qualità. In un quadro di contrazione delle risorse pubbliche, il valore del recupero del patrimonio esistente - nello specifico un frammento di archeologia industriale - rappresenta un'opportunità per validare la scelta conservativa rispetto all'ipotesi di sostituzione edilizia, rispetto alle variabili sociali ambientali ed economiche.