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# Urban Transformation of a Former Pencil Factory Complex—A Case Study of 'TOZ Penkala' in Zagreb

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**Abstract:** The subject of this research is the former Zagreb pencil factory ('TOZ'—Tvornica olovaka Zagreb), which manufactured pencils and pastels since 1937. During the 1970s and 1980s, it was one of the most important factories that produced school and office supplies. This paper investigates frequent changes grouped into several time and development phases, which are determined according to the most important structural and purposeful changes. This paper presents the data obtained through archival and field research to review the past in detail, assess the current state, and its architectural, urban, and identity features, and look critically to the future. Since 2015, the factory has been closed. The factory is awaiting the realization of the 'TOZ' urban development plan adopted in 2009. The research data collection methods include observations, reviews of existing records, documentation, and SWOT analysis. This paper's objectives are to explore existing site opportunities, address the potential and constraints, and evaluate the potential of the proposed urban development plan. This paper concludes with a look at the future of factory buildings. It faces technical, regulatory, and financial risks that might result in the site remaining neglected and unused for many years.

**Keywords:** urban development plan; industrial architecture; pencil factory; transformation; demolition; revitalization; Zagreb; Croatia



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## 1. Introduction

Neglected and abandoned former industrial sites in urban areas negatively affect the community's social, economic, and environmental development. They can be transformed into viable options. Urban transformation is understood as a new project and construction on the site of damaged and devastated areas of former building construction. By transforming unused industrial locations, project teams design new mixed-use districts with housing, retail, office space, and open-space areas to fulfill present and future needs. In a broad context, this case study presents the concept of the transformation of abandoned manufacturing plants and warehouses and the impact of the new project on the surrounding environment. This paper presents an example of a factory site transformation scheme waiting to be realized in the former pencil factory area, in the western part of Zagreb. This paper aims to define all the locations of the historical industrial complex from 1936 to the present day, to examine the current state and its architectural, urban, and identity features, and to evaluate this site's strategic direction. The main aim is to give evidence of the history of the well-known former pencil factory 'TOZ Penkala' (Tvornica olovaka Zagreb Penkala) and to determine its significance. It exists in a neglected and aging location and is part of urban transformation planning practice.

The precise classification of areas according to their redevelopment potential divides the land into five categories [1]: greenfield, brownfield, blackfields, bluefields, and greyfields. A greenfield is a pristine land that has never been developed. A brownfield is a property of which the expansion, redevelopment, or reuse may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Blackfields

are underused areas where redevelopment is needed, but the soil is heavily contaminated, unlike brownfields. Bluefields are waterfront sites with high flooding risks and subjected to extensive ecological laws, and greyfields are areas that have been developed and then abandoned.

In Croatia, there is no such precise classification and the 'TOZ' site is not an inventory of the brownfield sites in Zagreb [2]. According to the Spatial Development Strategy of the Republic of Croatia [3], brownfield areas are defined as "abandoned/omitted areas", which consist of abandoned properties or properties that have ceased to be used for their original purpose (buildings, infrastructure, regardless of the previous purpose) and are free for conversion and reuse. They result from economic changes caused by the decline in traditional industries in the 1980s, changes in the state structure, system reorganization, and the global financial crisis. In the Republic of Croatia, abandoned areas are present, and abandoned industrial, military, and tourist complexes stand out [4]. There is no equivalent for the term brownfield in the national languages of most European countries and Croatia. For this reason, the English word is generally used to mark this concept. Urban regeneration practice has not created a unique definition of the brownfield concept; therefore, the term's meaning is not uniform in academic discourse and practice. In ref. [5]., the research results revealed that differences expressed in the viewpoints of different stakeholder groups are not as pronounced as differences expressed between countries and their national frameworks. Also, brownfield mapping and inventory compiling are not centrally organized in most EU countries.

Recent Croatian history has witnessed war demolitions, post-war problems, transition, and the poor management of state-owned and privatized companies [6]. Zagreb is a significant source of industrial architecture. Historic layers of industrial architecture make up an important feature of Zagreb. Unfortunately, there are many neglected and aging industrial complexes. In recent decades, the city has been changing, developing, growing, shrinking, building, and demolishing. Urban areas, cities, and parts of cities are spatial and social entities that are gradually changing [7]. There are numerous procedures within complete urban transformation processes [8]. Urban transformation is a comprehensive term for all city processes, changes, and interventions. Urban transformation can be a new project and new construction on the site of the cleared and devastated area former building, a new project and construction on a free space, or an urban renewal of the city center, i.e., areas that, due to carelessness, or as a result of natural disaster, have lost some of their characteristics and qualities, which need to be restored and further improved to raise the quality of life in the city [9]. Historical industrial areas frequently refer to the context of industrial heritage, urban renewal, and to the context of the potential for redevelopment [10,11], tourism development [12,13], and place identity/memory [14–16].

The history of a factory is a presentation of historical progress depending on economic, social, political, and social circumstances at that time. In the western part of Zagreb, the factories are still present in the inhabitants' consciousness.

The site's redevelopment will have a strong economic and social impact on individuals and the local community. The complete urban and architectural site transformation will impact the current community identity. The lives of the neighborhood's residents will be improved by using the resources of the new district. The development plan addresses the sociocultural needs of the site's users (e.g., children's parks, sport, kindergarten, etc.). The prerequisites for socially fully integrated neighborhoods in new areas will be created with a quality building design and supporting infrastructure. The design must be flexible enough to allow for social changes and local choices. The economic impacts of this transformation will occur at different spatial scales. In addition to the direct economic impact of construction, the development will also bring indirect impacts. It might stimulate the wider regeneration of this part of the city, while a residential development will lead to a more favorable perception of this area. In a project context, the public participation purpose (community engagement) is to provide opportunities for public perspectives to inform and influence the planned transformation under consideration.

This research begins with an overview of the study area, materials, and research methods implemented, and a comparison to other European and Croatian examples. Furthermore, this paper describes the former pencil factory 'TOZ' in Zagreb, for which a detailed analysis has been conducted. The past, present, and future states were elaborated on and discussed. Finally, it summarizes the main results of the analysis performed. The principal conclusion is the necessity for the urban transformation of the existing part of the city.

## 2. Materials and Methods

### *2.1. Study Area—The Pencil Factory 'TOZ Penkala'*

This paper presents an example of an urban transformation scheme waiting to be realized on the former pencil factory 'TOZ Penkala' in Zagreb's district of Stenjevec, in the western part of Zagreb. It was a settlement that arose on the outskirts of Zagreb. After the Second World War, it officially became part of the city. The settlement was built in the 20th century and developed parallel with the industry (including the TOZ factory and the nearby 'Pliva' and 'Ciglana' industries). It was inhabited by the working and middle class, who were employed in nearby industrial manufacturing. The factories were the initiators of the building construction in the surrounding districts [17]. Most of the family houses built in the closest vicinity of the factory were workers' houses. All existing industries in the area (except the 'Pliva-Teva' group) are closed today, and the industrial buildings are planned for demolition.

The present case study explores the concept of the transformation of an abandoned manufacturing plant and the impact of the new project on the surrounding environment. The subject of this research is the former Zagreb pencil factory, which had manufactured pencils and pastels since 1937. The pencil factory 'Koh-i-Noor L.L.C. Hardmuth' was founded in Zagreb in 1936. At the beginning, the factory had 28 workers. It was a small plant for manufacturing pencils and pastels at one location—Prilaz baruna Filipovića. It later grew into a large factory to produce school and office supplies at another location—Poljačka Street [18] (Figure 1).


**Figure 1.** Site plan of the pencil factory 'TOZ' in Zagreb. 1: In Prilaz baruna Filipovica in Crnomerec district until 1970; 2: In Poljacka Street in Stenjevec district from 1957 until today; S: Ban Jelacic Square as the central city square. Source: Drawn by authors, according to Geoportal Grad Zagreb (https://geoportal.zagreb.hr/Karta, accessed 14 August 2024).

The 'TOZ' site was initially researched during the Master Thesis Studio in the 'Architecture and Urbanism graduate program at the Faculty of Architecture University of Zagreb [19]. In the students' education and preparation for future professional activities, working on the Master Thesis Studio, the opportunity to research themes that deal with preserving the inherited built urban environment of urban areas is possible. The background of this paper is the master thesis project entitled Kindergarten 'TOZ Penkala' [20]. It was designed at the 'TOZ' factory location. The master thesis studio research included establishing the context for the design project and creating a dialog with the recent past. The plot in Poljačka Street comprises the facilities of the former pencil factory 'TOZ Penkala' in Zagreb (Figure 2).


**Figure 2.** The site plan of the 'TOZ' pencil factory complex is marked with a yellow line. Source: Geoportal Grad Zagreb (https://geoportal.zagreb.hr/Karta, accessed 14 August 2024).

The 'TOZ' site boundaries are the railway corridor and the railway container terminal in the north, the military police complex in the west, and family houses in the east and south. The 'TOZ' complex forms one large plot (64,350 square meters) and occupies the eastern part of the whole area, the north-western corner is unbuilt, and warehouses and secondary facilities are in the southwestern part.

### *2.2. Methods*

An interpretive historical research method, a method of superimposing and comparing archival plans and drafts with present-day drafts and plans, historical and contemporary photographs, and field research, was applied to analyze, compare, and evaluate the 'TOZ' case study.

The research is supported by a combination of archival data, field research, and comparative analysis, offering relevant insights into the transformation of the unused industrial site.

- The article provides a comprehensive historical overview of the factory, including its various transformations. Including timelines and architectural plans enhances the understanding of the site's evolution.
- The paper thoroughly evaluates the site's present condition, addressing the decay of existing structures and the complex's greenery. This section demonstrates the urgent need for redevelopment.

- The SWOT analysis is used as a methodological approach to assess the internal and external factors influencing the potential transformation of this site. It adds depth to the discussion of urban redevelopment and effectively highlights the strengths, weaknesses, opportunities, and threats of repurposing the factory site.
- The comparative analysis of European examples of industrial site transformations provides a more grounded analysis of the practical feasibility of the proposed plan and highlights the broader implications and lessons learned.

Figure 3 shows the outline of the research.

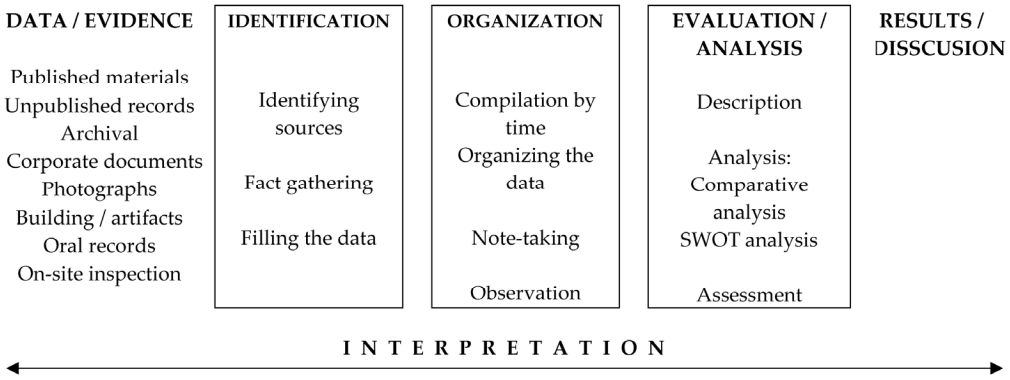



**Figure 3.** Methodology for interpretive historical research.

The research data collection methods included historical sources to study and interpret the past. The research included reviews of existing documentation and archive records in the State Archives in Zagreb. Primary sources are original materials created during building construction. They are valuable sources for analyzing and interpreting events from multiple perspectives. Published sources (newspaper articles, annual company reports, and catalogs) and unpublished sources provide direct evidence of historical events included in official documents created by those who participated in the events of the past (drawings, drafts, government records, typewritten records communications, etc.). In addition to document-based materials, field research was conducted to collect data in a natural setting. Apart from a visual inspection of the factory buildings to create the master thesis project, digital photographs of the found state were made. Oral histories and interviews with eyewitnesses were also conducted. On-site interviews in March 2023 about the industrial past with the former 'TOZ' employees and temporary new users were conducted to gather specific data and gain insights into the thoughts of different individuals (users). Secondary sources (books and journals) were created later and are important because they provide context for and analyses of historical events. A valuable source of information was the book published by the 'TOZ' factory in 1977 for its 40th anniversary [21].

The nature of historical sources allows us to gain a deeper understanding of the factory's past and construct a more accurate interpretation of historical events. The origin and authenticity of the sources were the main factors to consider when assessing the nature of historical sources to ensure their accuracy and relevance. Also, the availability of diverse sources that offer different viewpoints and the ability to compare multiple sources to verify the information.

The research presented in this paper consists of three main stages:

1. Identification of the sites and history of the pencil factory originating from 1936.
2. Organization of collected data, compilation by time, and interpretation of the current state and adopted plan from 2009.
3. Evaluation and the analysis of the case study.

In the first stage of this research, exact spatial locations were identified. Two main sites were confirmed from 1936 to the present day. The selected case study focused on the long and detailed past of the former pencil factory that changed its name seven times.

At this research stage, historical plans and archival designs were analyzed to assess the architectural and urban changes that took place over time. The genesis of the factory was defined.

In the second stage of the research, organization, compilation, and interpretation of the current location of the existing industrial complex were carried out. Identification was performed by analyzing and comparing archival drawings and situations, available literature, photographs, and field research. Afterward, an analysis of the adopted plan was made. The case study refers to the devastated industrial area. The pencil factory closed its manufacture in 2015. The location is neglected and gradually disappearing from the city fabric. The 'TOZ' Urban Development Plan from 2009 defines new uses in the future.

Lastly, the third stage of research focused on evaluating the case study. This stage comprised the comparison of the current state and the adopted plan. The evaluation was based on drafts, situations, and field research. In addition, collected materials related to the selected case study were visually and descriptively interpreted to define the use of the area. Finally, the SWOT analysis was used to compare external and internal influences on the site, to bring out the relation to the built environment and the value of the area. Furthermore, scientific and professional literature published by foreign and domestic authors was reviewed. Comparative examples of successful former industrial transformation sites in other countries and Croatia were made.

### *2.3. The European Context*

In urban development and consequently urban transformation, discussing industrial sites and conservation concerns is an issue of planning practice. Many European planning traditions have implications for industrial heritage and different understandings of conservation and development [22]. There are diverse approaches to the theory and practice of managing built objects [23]. There is no unique definition of a historical industrial area. It is a concept that comprises a complex combination of areas and buildings, people, practices, and machines [24]. There is a wide range of industrial areas (existing, former, abandoned, reused, demolished, and brownfield). The terms are clearly defined at the level of historical building interventions. Then, various well-defined conservation procedures are applied (reconstruction, regeneration, conservation, restoration, rehabilitation, etc.) [25,26].

In the available foreign literature, industrial areas are viewed in the context of the adaptive reuse of industrial heritage [27–29], the regeneration of industrial brownfields [30], and the revitalization of historical industrial areas [31]. The transformation process tries to articulate the conditions under which the useful life of the original structure has come to an end. At the same time, this serves to find prospects for feasible reuse, and possible paths through demolition, removal, and redevelopment phases [32]. The recognition and management of industrial heritage sites—as protection (conversation), re-uses (revitalization and regeneration), or partial demolition—go together with confrontation in planning practice. Industrial sites, buildings, and structures not subjected to legal preservation requirements are condemned to be demolished. The demolition of whole factories or partial demolitions is a complex work. Industrial structures make demolition riskier and demand extensive decommissioning and waste management planning [33,34]. Economics is undeniably a major determinant in practical decision making [35].

This case study is about the end-stage of built structures, i.e., demolition. There are many examples of demolished former (and once famous) factories, usually situated in the outer areas of a city, and being transformed for new uses. Nowadays, numerous cases are specific to a particular community but suggest paths of inquiry and action pertinent to architectural legacies elsewhere [36]. The residential project Tuborg Salt Meadow located on the former Tuborg Factory site north of Copenhagen is expected to be completed in 2025. The former industrial brewery estate has been developed into a new urban district. The old master plan envisioned housing blocks throughout the site, which carved the area up in a way that left little space for communal spaces and nature. The new plan for the former Tuborg factory site in collaboration with Gentofte Municipality was created in 2008.

By moving the residential buildings closer to the coast and placing parking underground, a large nature area increases the biodiversity of Danish coastal landscapes [37,38]. The desolate site of Continental Rubber Factory in Linden-Limmer in Hannover from the late 19th century was demolished to make way for a housing development called Wasserstadt Limmer. The factory successfully produced tires for the automobile industry and was a great part of the history of rubber production in general. However, the infrastructure fell out of date, and it was impossible to renovate the complex. All operations stopped in 2000. At present, an architectural competition is underway [39–41]. The Ghent industrial site Bijgaardehof was converted into a residential development in 2021. A former Malmar metal factory closed in 1997, an architectural competition took place in 2009, and the abandoned site is being converted into 59 residential units and a health center. The residential complex is self-sufficiently supplied with geothermal energy [42,43]. Strijp R, the former industrial site of 'Phillips' in Eindhoven, was transformed into a new, residential area. The Phillips Company built its first factory in 1891 to manufacture television tubes. The Urban Development Plan for the redevelopment and the Spatial Quality Plan were set in 2006–2010. Within the ring structure of the urban spatial master plan are several freely subdivisible development tracts, criss-crossed by an amorphous green belt that meanders between the various housing clusters. (from 2016 under construction) [44,45]. Eternitten in Aalborg is another interesting example. The Danish Eternit factory was established in 1927 and was the most successful in the 1960s, but due to globalization, the business slowly died out. In 2004, the company was sold and the production of building materials ended. The objective was to redevelop the industrial site as a unique place that captures the aura of the factory with residential buildings, mixed-use urban space, and the industrial sector through cooperation between developers, the City of Aalborg, and residents. The former industrial area has become a mixed-use urban district with residential units, workplaces, stores, cafes, and amenities [30,46].

### *2.4. Circumstances in Zagreb*

The arrival of the railway (the Vienna to Trieste railway line) in 1862 marked the beginning of modernization in Zagreb. From 1865 until the period between the two world wars, Zagreb was turned from a small administrative and trade center of the Habsburg Empire into a modern industrial center of the Kingdom of Serbs, Croats, and Slovenes. Zagreb authorities provided basic urban planning documents, building codes, and regulatory plans to meet the challenges of transforming a medieval city into a modern metropolis in the second half of the nineteenth century. The town planning documents of Zagreb from 1865, 1887, 1905, and 1923 were concentrated around the establishment of a network of new streets and squares, the organization of communal infrastructure, the shaping of green areas, and the functional zoning of the town [47,48]. The key to designing urban models was the ability of architects to critically evaluate and accept knowledge in urban planning models [49]. In 1930, the city launched an international competition for the Zagreb master plan. The 1932 regulatory plan of Zagreb embodied the concept of a functional city in an official planning document. The plan has clearly defined zones, freestanding apartment buildings surrounded by greenery, a network of public and residential streets, and education, social, and supply facilities. Besides contemporary urban planning models, it encouraged the foundation of urban planning institutions and educated the first generation of urban planners. It was the starting point of urban planning in the 1940s and 1950s. After the Second World War, the period of post-war reconstruction and the construction of a new, socialist society begins. During the socialist period, urban planning was a part of state politics, which was uniform and interdisciplinary. Social ownership over the land gave many possibilities to the state as a collective owner to organize centralized, well-defined, and long-term planning of urban areas. There was a tendency to preserve space. Urban planning was guided by strict building principles and a clear definition of public space as open and accessible to everyone. Primary and secondary infrastructure accompanied new housing developments. In the post-socialist period, since from the 1990s onwards, major

social, political, and economic changes have happened in Croatia and especially in Zagreb. A completely different attitude to space characterizes post-socialism: no strategic and long-term planning, no comprehensive plans of settlements, and no careful consideration of spatial development [50]. Private developers and entrepreneurs are quite strong and can reorganize urban plans with their investments in separate buildings and settlements. After Croatian accession to the EU in 2013, all related European policies and regulations needed to be transposed or directly implemented.

In Croatia, historical industrial complexes and factory facilities are protected as industrial heritage due to their historical and architectural values and are listed in the National Registry of Cultural Goods [51]. These are usually located in today's city centers and have a prominent place in the architectural heritage of Zagreb [52–54]. Križaj [55] provided data standards for the architectural heritage inventories in Croatia. Paladino [56] showed a detailed chronological account of the production of conservation plans and the protection of Zagreb's industrial heritage. The Zagreb City Museum's Project, a research project on the deterioration and uncertain future of industrial sites in Zagreb, gave comprehensive insights into the importance of industrial heritage in Zagreb. The project included study exhibitions and guided tours for the public [57]. Historical industrial areas are often mentioned in the context of individual architects' work research [58], the history of families and factory owners [59,60], locations of well-known factories [61,62], or the industrial architecture of other Croatian cities, for example, in Osijek [24], Rijeka [63], or Dubrovnik [64].

Zagreb has many former factories in attractive locations. There are examples of successful conversion projects of the former industrial facilities. They are all protected industrial structures and factory complexes, built from the 1890s to 1940s. They are to be transformed into public, business, or residential facilities. Due to the location, sites are relevant for the urban development of the center of Zagreb. Some have privately led developments, like the successful project Lauba—People and Art House, converted from a former textile warehouse into a private-owned contemporary art gallery in 2007. The City of Zagreb purchased many sites, and they are strategic investment projects. Riding Stable was originally part of the Austro-Hungarian military complex in 1903 and transformed into a contemporary space for the Land Registry Department of the Municipal Civil Court in 2022. The building is located in the southern part of the forthcoming Justice Square, which is a winning design from an urban and architectural competition for the location [17]. Military brownfields in western Zagreb at the sites of former barracks at Španska and on Selska Street are transformed for residential use. Among the more significant examples of such conversions are the conversion of the barracks in Borongaj into a university campus and the conversion of the former Vlaška Street Military Hospital into the Elly Bašić Music School [5]. The Croatian Conservation Institute will move into the buildings of the former Zagreb Tobacco Factory from the 1880s on Jukićeva Street. The industrial complex of a steam-powered mill to produce flour (Zagreb Steammill), originally built in the 1860s, is now under reconstruction according to the awarded first prize in a competition for a new city library in 2019.

There are also negative examples of abandoning historical industrial areas, which are then devastated or turned into brownfields [65]. Some complexes are not protected as cultural monuments, therefore, there is no legal protection from their demolition. The abandoning of industrial activity in the form of old abandoned factories, industrial warehouses, and other accompanying facilities left traces in Zagreb. These are symbols of industrial decline and failed former factories. Stories of industrial workers and shut-down factories in Europe are similar [66]. Recalling the industrial past and preserving the social memory most often belong to blogs and activist sites with occasional extensive media reporting. The lack of scientific research and publications on professional demolition/preservation experience has been detected.

Under the collapse of socialism during the 1990s, with the processes marked by globalization, many markets, conversion, and privatization, the decline and extinction of factories

and industrial sites began. Zagreb is not an isolated case, but rather an example of the regular manner of treating industrial sites in Croatia. There are many such examples from Zagreb. The former silk factory 'Bubara' on Adžija Street from 1892 was recently destroyed. The former 'Kamensko' company for clothing production from 1949 on Reljkovićeva Street ceased operations in 2018. Today, a luxury residential and business complex was built in that location in the city center. The former company for furniture production 'Šavrić' founded in 1948 went bankrupt in 1999 and closed in 2004. On its site, the new shopping center 'Solidum' was built. The former women's clothing factory 'Vesna' founded in 1955 in Nova Cesta, went into bankruptcy in 2000 and liquidation was carried out in 2005. The factory was partially demolished and for several years it was waiting to be converted into a residential and business complex, which is now in progress [67]. The former 'Nada Dimić' textile factory on Branimirova Street, established in 1923, went into bankruptcy in 2000 and has an uncertain future. Although it is the result of the work of great names in Croatian architecture, its structure is being neglected by its owners and institutions, and thus deteriorating without being given a new purpose [68].

## 3. Development of the Case Study

### *3.1. The Past: Transitions and Transformations over the Years*

Throughout its history, the 'TOZ' company has had many inevitable transitions (social order, management, and governance) and transformations (change of headquarters, name, production program, and number of employees) (Figure 4).

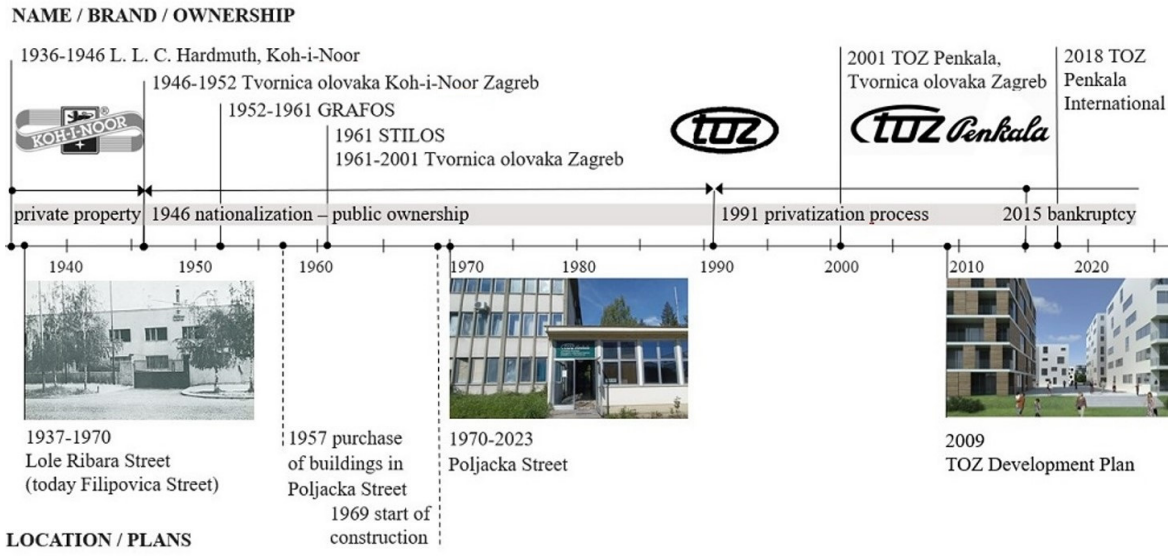



**Figure 4.** Timeline of transitions and transformations of the pencil factory 'TOZ' from 1936 to the present day.

The company was called 'Koh-i-Noor L. L. C. Hardmuth' (1937–1946), pencil factory 'Koh-i-Noor Zagreb' (1946–1952), 'Grafos' (1952–1961), 'Stilos' (1961), 'TOZ'—pencil, school, and office supplies factory Zagreb (1961–2001), 'TOZ Penkala'—pencil factory Zagreb from 2001, and 'TOZ Penkala International' in 2018 [69]. The recent name of the factory comes from its first product—pencils. More modern pens replaced wooden pencils, but the manufacture of wooden pencils continued until 2015. The brand, the name, and the design relate to actual products and create an emotional association in the consumer's consciousness. The 'TOZ' school and office supplies were well-known products in Croatia. [70]

#### 3.1.1. Baruna Filipovića Street

The first pencil factory 'Koh-i-noor L. & C. Hardmuth' established in Zagreb dates from 1936, when brothers R. and Š. Fürst from Zagreb and three partners—F. Hardmuth

and F. Herring from České Budějovice and M. Salins-Spallek from Vienna—founded the public company and started manufacturing pencils and pastels in 1937 [71]. The first factory was on Baruna Filipovića Street 97 (later I. L. Ribara Street 91 and today's Prilaz baruna Filipovića) in the Črnomerec district. Architect B. Šuperina designed the technical drawings of the factory in 1936 (Figures 5 and 6).

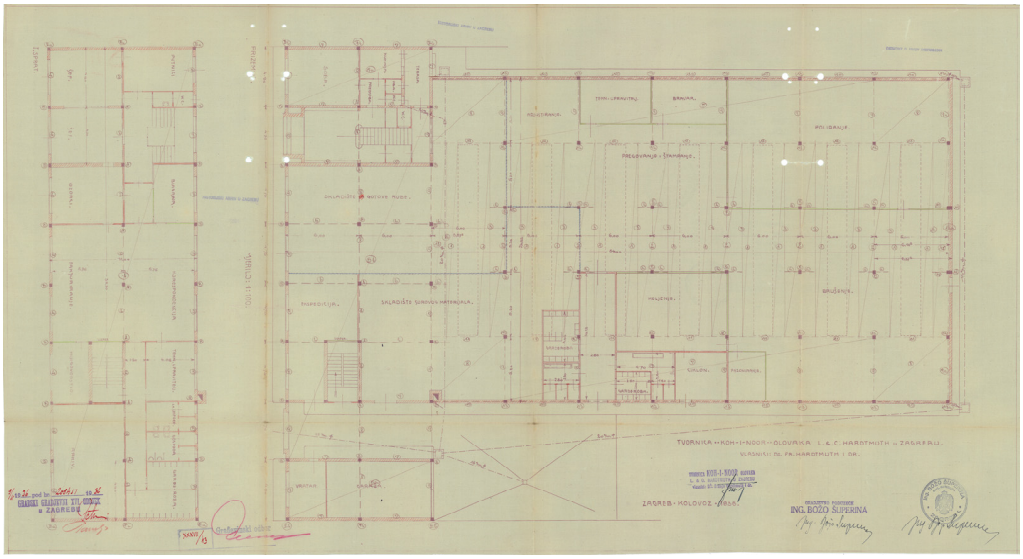


**Figure 5.** The pencil factory 'Koh-i-noor L. & C. Hardmuth' in Baruna Filipovica Street, Zagreb, August 1936, ground floor and 1st floor plan 1:100. Source: State Archives in Zagreb (HR-DAZG-1122 ZGD TOZ-3245).

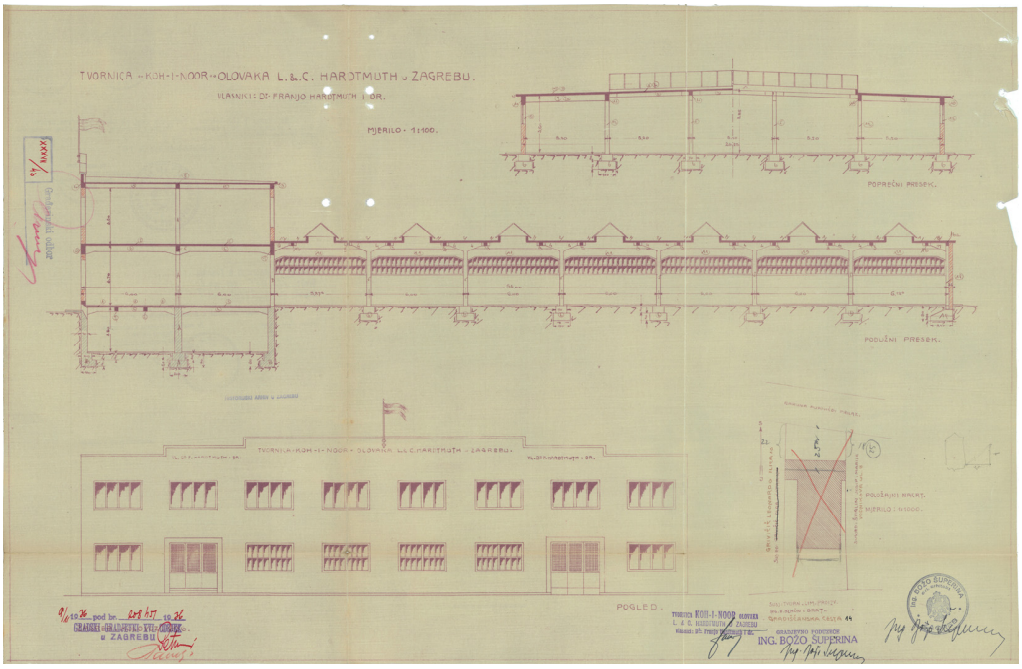



**Figure 6.** The pencil factory 'Koh-i-noor L. & C. Hardmuth' in Baruna Filipovica Street, Zagreb, 1936, sections and street façade 1:100. Source: State Archives in Zagreb (HR-DAZG-1122 ZGD TOZ-3245).

The factory has a t-shaped layout plan (app. 38.5 × 54 m) that consists of a two-story administrative and yard ground-floor manufacturing building (with a warehouse of finished goods, a raw material warehouse, as well as a grinding and a gluing workshop). In 1937, the street fence was built (Figure 7).

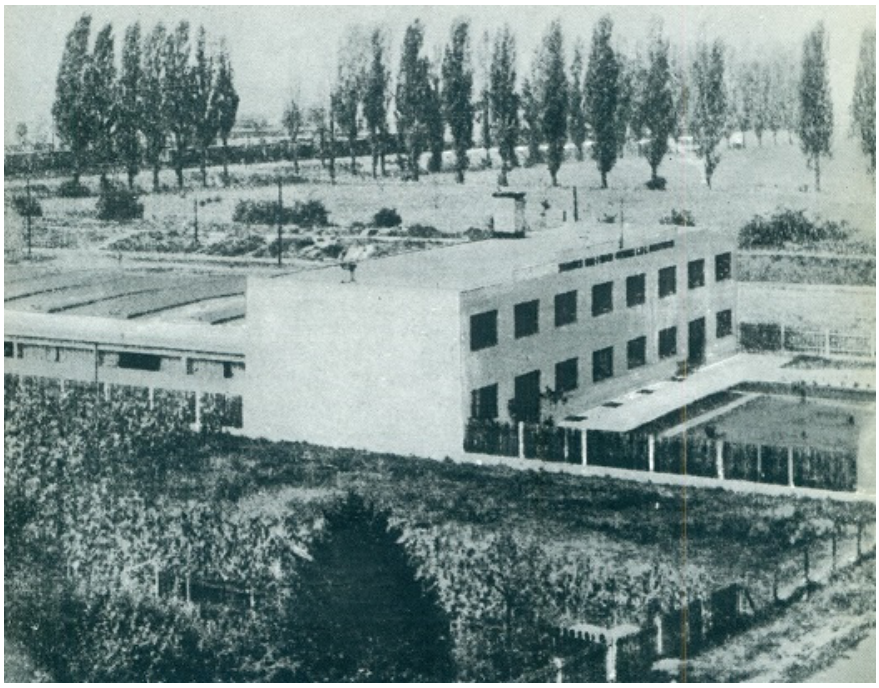


**Figure 7.** The pencil factory 'Koh-i-noor L. & C. Hardmuth' in Baruna Filipovica Street, Zagreb, 1937. Source: reference [21] (p. 41).

Many upgrades, renovations (the wood drying room and a garage), and extensions were made in the following years. In 1942, a wood processing facility was built, followed by a silo for sawdust in 1943.

The pencil factory 'L. & C. Hardtmuth' was founded in 1790 by Josef Hardtmuth in Vienna, Austria [72]. In 1848, the company was moved to Budweis (České Budějovice) in Czechia. In 1888, they introduced the 'KOH-I-NOOR' pencil. Today, the company operates under the name 'KOH-I-NOOR HARDTMUTH', although the company no longer belongs to the original owners of the Hardtmuth family [73]. The Czech manufacturer Hardtmuth established branches with the final stages of production, so imported goods were given a domestic form and various privileges. The wood was not processed in Zagreb and the mines were not produced outside the headquarters. It was not possible to import cedar wood from the USA during the Second World War, so wood processing and the production of mines started in Zagreb. On 4 March 1945, the factory was destroyed in an air raid on Zagreb West Station, and manufacturing was suspended [74]. The draft of destroyed and damaged parts of the buildings is shown in Figure 8.

Rihard Dworžak from the construction company in Zagreb, Palmotićeva Street 13, made plans for reconstruction. The factory was renovated in 1946 and became a state-owned company. In 1950, it merged with the companies 'Četkara' and 'Albuminat'. At that time, it employed 120 workers, expanding the range of products. Since the initial production of classical writing supplies, the company has broadened its offer with modern writing, drawing, and painting products. In 1952, the first export was made to Great Britain. Manufacturing facilities (ink and glue) were added. The factory expanded its facilities. In 1951, the garage and boiler room were renovated. A chimney for central heating was built. In 1952, a fence around the factory complex was built. The renovation of storages and garages followed. The factory for mine production and wood drying room were built. In 1953, there was a floor addition. All the additions and renovations were designed by the architect M. Grakalić from the architectural firm 'Arhitekt—građevinsko-projektna zadruga Društva arhitekata Hrvatske' in Zagreb. In the mid-1960s, products were no longer handmade. New machines and technological lines were purchased for different plastic and metal parts used in the manufacturing processes. After 20 years, the site was fully built, and enlargement was needed.

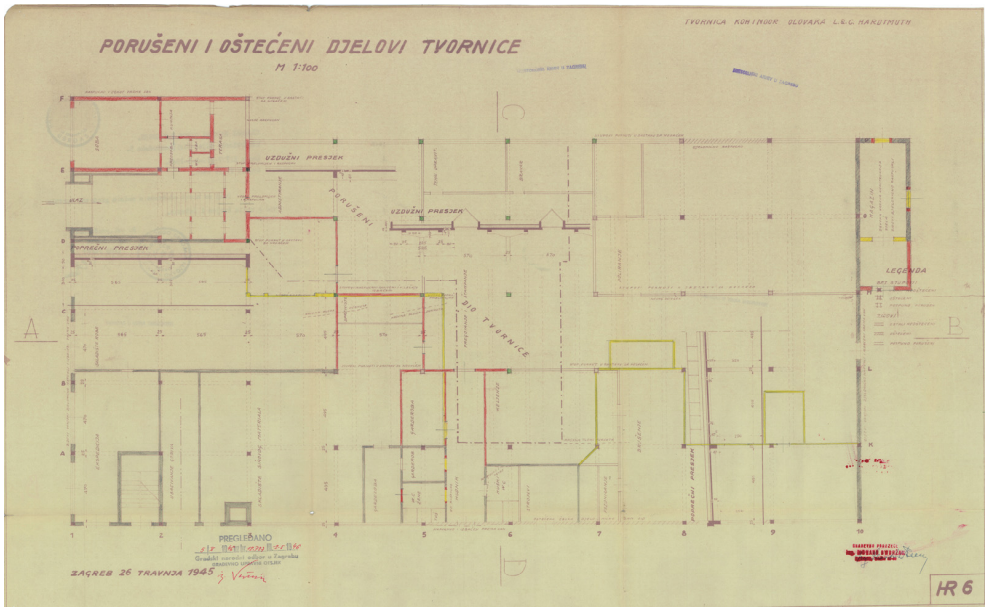



**Figure 8.** Destroyed and damaged parts of the pencil factory 'Koh-i-noor L. & C. Hardmuth' on Baruna Filipovica Street, Zagreb, 26 April 1945. Destroyed parts are in yellow and damaged parts are in red. Source: State Archives in Zagreb (HR-DAZG-1122 ZGD TOZ-3245).

### 3.1.2. Poljačka Street

An expansion project and a move to a new location were carried out due to production growth and the need for larger production facilities. In 1957, the company 'Sortirnica' on Poljačka Street 56 was purchased and the move to a new location began in 1958. Drawings of the new factory complex were made by the architectural firm 'Graditelj—Biro za urbanizam i projektiranje'in Zagreb, Amruševa Street, in 1964. The head of the firm was engineer E. Čustović, the chief architect Dž. Hilami, and collaborator architect D. Grižov (Figure 9).

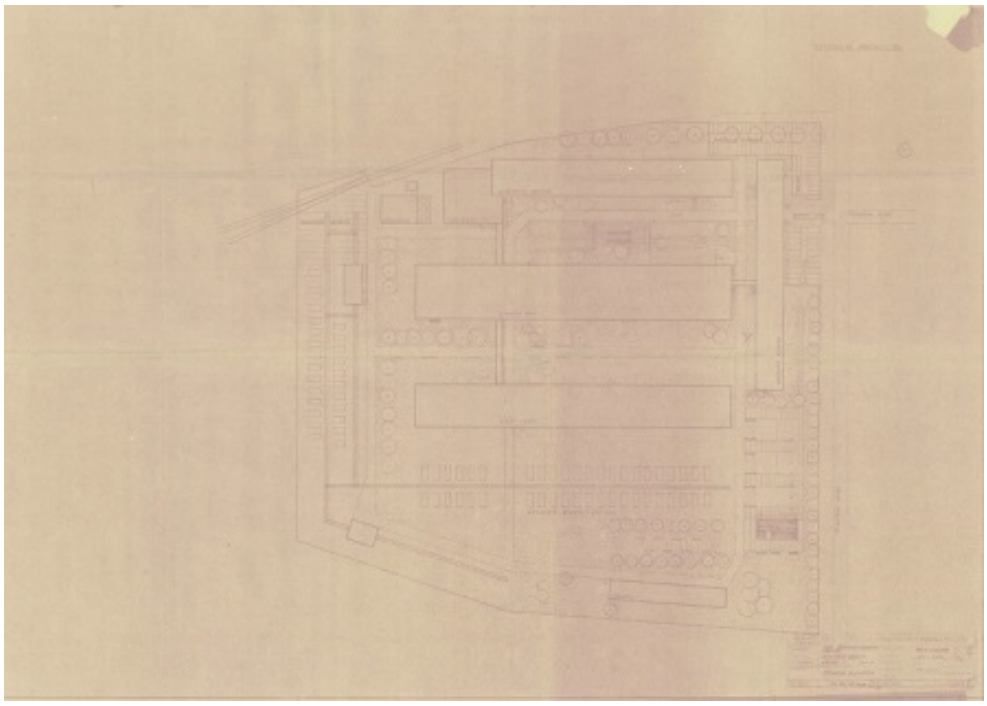


**Figure 9.** The 'TOZ' factory, construction plan, 1965. Source: State Archives in Zagreb (HR-DAZG-1122 ZGD TOZ-3137).

In 1968, a contract was concluded with the 'Pliva' factory to sell the factory building at I. L. Ribara Street 91. The construction of new production facilities and the partial relocation to a new location began in 1969. In 1970, production at the location in I. L. Ribara Street completely stopped and the factory moved to the newly built facilities on Poljačka Street. The complex expanded until the 1980s. The layout of the entire complex and its organizational scheme can be read in Figure 10a,b.


(**a**) (**b**)

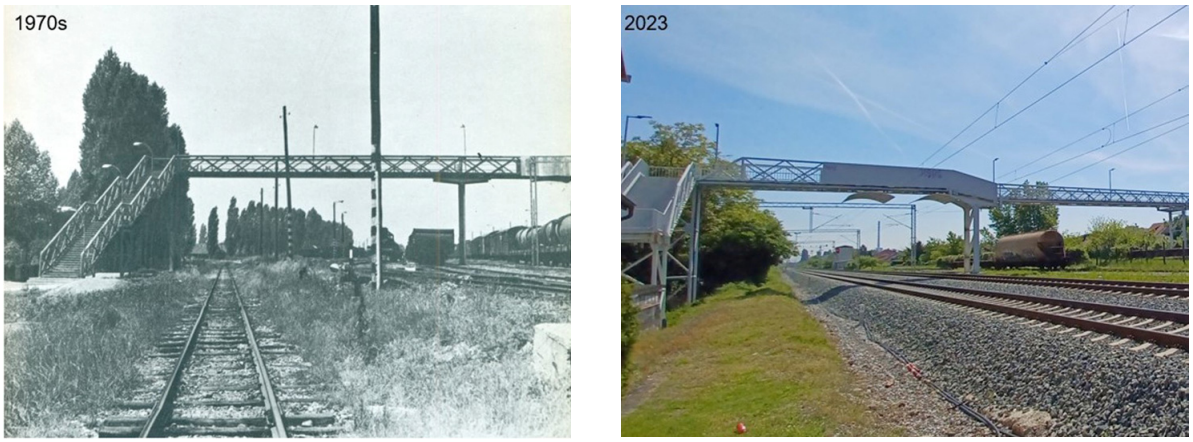
**Figure 10.** 'TOZ' factory complex on Poljacka Street: (**a**) Layout—A: Main entrance from Poljacka Street; B: Former recreational area—B1: outer swimming pool; B2: sports field; L: Landscape—L1: Landscape unit 1; L2: Landscape unit 2; L3: Landscape unit 3. Buildings—1: Existing (first) building on the site (bought in 1958); Buildings built from 1969 to 1970—2: Main manufacturing hall; 3: Third manufacturing hall; 4: Administrative building; 4a: Restaurant; 5: Storage and utilities. Source: Authors, according to Geoportal Grad Zagreb (https://geoportal.zagreb.hr/Karta, accessed 14 August 2024); and (**b**) Areal view from the East during the 1970s. Source: reference [21] (p. 60).

The factory complex's main pedestrian and vehicular entrance is from the east. The administrative building with three floors is located immediately at the entrance and is positioned along the longer side in the north–south direction. In the north, a ground-floor porter's office was added, as the main control point of the entire complex. A taller one-story building (which housed a restaurant) was built to the south. Viewed from north to south, three parallel manufacturing halls are lined up on the plot, with the longer sides in the east–west direction (the existing building from 1957 and two new buildings built in 1969–1970: the main manufacturing hall and manufacturing hall nr. III), which in the west are connected on the upper floors, and movement is enabled on the ground floor. There is an industrial boiler room in the northwest. Storehouses and outbuildings are positioned in the south, and later also in the west. The unloading of goods and finished products is an integral part of the transportation process and is organized in the West. Outdoor sports fields are in the south along the very edge of the plot.

The pencil factory was in full force in the 1970s and 1980s. During the 1970s and 1980s, TOZ was one of the most important labor organizations in Zagreb, and the Yugoslav economy. In the second half of the 1980s, the company had 44 product groups (plastic packaging, folders, markers, etc.), an assortment of 570 items, and about 1000 semi-finished products. With approximately 800 employees, the factory produced around 300 million pieces of different goods. The work was systematically divided according to socialist self-management ideas. The 'TOZ' company aimed to create the best possible working and living conditions for its employees. In addition to production facilities, workspaces, and warehouses, the complex also had sports and recreation areas built from 1972 to 1975. A two-lane automatic bowling alley, a hall for table tennis and chess, sanitary facilities, and a cloakroom were built. An open swimming pool, a football and volleyball court, and two bowling alleys were arranged outside. The factory invested considerable resources in

the communal infrastructure of general importance (sewerage, substation, water supply, asphalting of streets, and traffic lights, etc.) [21].

In 1970, the factory also had a pedestrian overpass built over the railway connecting Donja Kustošija and Ilica. The overpass was built with the funds of 'TOZ' to facilitate the arrival of many workers to work from the Western part of the city. The 200 m long facility above the railway provided access from Ilica, crossing over several railway tracks, going down to today's Radgonska Street, continuing to Poljačka Street, and access to the main entrance to the factory complex from the east from Poljačka Street (Figure 11a). After 50 years, the pedestrian crossing was in poor condition and posed a danger to users, so in 2018, an action was launched to restore it. The first works started on the staircases outside the railway corridor. Damaged structural parts were repaired, parts damaged beyond repair were replaced, anti-corrosion protection was used, and new lighting was installed [75]. This pedestrian crossing is one of the few old overpasses along the railway line in Zagreb that still exists [76] (Figure 11b).




(**a**) (**b**)

**Figure 11.** Pedestrian crossing over a railway corridor: (**a**) In the 1970s. Source: reference [21] (p. 107); and (**b**) Today. Photo by authors.

In the 1970s, the factory invested in the reconstruction of the plant and warehouse. Substantial investments have been made in improving working conditions, social standards, and recreation. In 1975, the sports club TOZ was founded, which, in addition to factory workers, gathered members of the surrounding schools, local communities, and other work groups. Two sports clubs were active: bowling and basketball, and sections: soccer, volleyball, table tennis, chess, and bocce. Social meals were organized on the factory grounds in a restaurant with 250 seats and a capacity of 600 meals per day [18]. The factory took care of the workers, providing them with more favorable loans, loans to build a house, and awards for inventions or production improvements. The first aid clinic was opened for the workers' health. The new manufacturing building (3700 sq. m.) was built in 1976. In 1984, the factory complex expanded to the western part by 24,000 sq. m., so the total area of the complex is 66,000 sq. m. (among which 22,000 sq. m. were built). The factory occupies the largest area (37,012 sq. m.). Tradition in production, the accelerated and sustainable development of modern technologies, and specialization in strategic product groups secured an important position on the market, among customers, consumers, and the public. Approximately half of the production was exported to the world market. The export countries were the USA, Germany, Turkey, Italy, Macedonia, and Bosnia and Herzegovina.

The privatization process was carried out after Yugoslavia's breakup and Croatia's independence in 1990. Factories in Croatia were converted and privatized. In 1993, the TOZ factory became a joint-stock company; in 2001, it was renamed 'TOZ Penkala'. The brand 'TOZ Penkala' resulted from cooperation between the factory and K. Penkala, the son of the famous inventor S. Penkala [77]. The company introduced the foundations of

the "Penkala" tradition into its operations by introducing products under this trademark. The partnership started in 1998 when the factory started producing Penkala ballpoint and fountain pens and added 'Penkala' to its name in 2001. An effort was made to strengthen the company's operations by supplementing the company's name and creating product recognition with the help of a well-known logo. The name and design associated with the products themselves create an emotional association in the minds of consumers; however, during the 2000s, the factory's operations became difficult. In 2012, the factory had a blocked account (due to illiquidity and insolvency). In July 2015, after 78 years of existence and business, the factory went bankrupt, 40 workers were laid off and the factory was closed [78]. Since 2018, it has been operating under the name 'TOZ Penkala International Ltd. [18].

### *3.2. Current State: Uncertainty and Decay*

Zagreb has fragmented areas of former factories in attractive locations, in the wider city center, and along the railway line. According to the Masterplan of the City of Zagreb [79], no immovable cultural assets in the 'TOZ' area are recorded. Existing industrial structures are not valued as important architecture that had to be preserved in any form.

The challenges of investing in uncertain times lead to the lack of investment in repairs. Unfortunately, long uncertainty develops the further decay of existing buildings. Several property characteristics are essentially impossible to upgrade. The value of the existing architecture is debatable, considering the numerous inadequate additions in the late 1980s. Adding a pitched roof to a flat roof was one of the frequent renovation methods. The appearances of the main administrative building's at the time of its construction in 1969, at the peak of its glory in 1977, and in its current state are compared in Figure 12.


**Figure 12.** Administrative building in Poljacka Street in 1969 and 1977. Source: reference [18] (p. 59 and p. 7). In 2023. Photo by authors.

Today, most buildings have no function. Some buildings are occasionally rented for small private businesses or recreational purposes (gym, etc.). During the fieldwork (3–5 March 2023), personal informal interviews about the industrial past with the former 'TOZ' employees and temporary new users in rent were performed. Interviews were conducted off- and on-site at a specific location relevant to the project to gather specific information. The informal interview was conducted as a preliminary step in the research process to generate ideas about the subject being investigated and to gain insights into the thoughts of individuals. Such interviews are entirely informal and are not controlled by a specific set of detailed questions. First, an interview with two former employees was conducted off-site. In the settlement around the factory, the former workers of the 'TOZ' factory, now elderly people, still live in family houses. Targeted questions about the working conditions at the 'TOZ' factory were asked at their home. The interview was conducted spontaneously and informally. Former factory workers are very emotional about their previous job, have strong feelings about the 'TOZ' company, and are disappointed with the poor conditions of the factory [80]. Many have spent their entire working life in the 'TOZ' factory, and some worked seasonally.

Second, personal informal interviews were also conducted on-site with different individuals (users). The factory complex is fenced, the property visit should be announced, and the entry should be registered. The porter at the main gate still guards the facilities. During the on-site visit, in the former meeting room in the administration building, we were introduced to the factory bankruptcy manager, whose duty is to take care of a collapsing complex. He permitted us to walk through the factory site and took us through the empty, but fully furnished administration building. The spirit of the past and the prosperity of the factory can be felt in the rich office's interior, i.e., with corridors paved with terrazzo, wooden wall paneling, ceiling hanging clocks, and a modern two-legged staircase (Figure 13).

**Figure 13.** Interior of the administrative building on Poljacka Street in 2023. Photo by authors.

Expected observations from the new users of the factory complex were also collected. Personal informal interviews with renting users were performed on-site [81]. The interviews were conducted in the large hall of the former restaurant, now a large room with workplaces. New users are not attached to the 'TOZ' history and are not burdened with its heritage. They look at the place from an economic point of view because they rent the available large working space for a moderate rate. They are satisfied with the current situation.

Green areas with high greenery are recorded within the boundaries of the 'TOZ' site (Figure 14a).

Valuable trees are found on the plot. The plant fund of the area consists of coniferous species and deciduous trees, which together form an organized spatial unit and provide unavoidable landscape and environmental value. Valuable greenery has been valorized as the three landscape units [82]. Landscape Unit 1 covers the highest quality high greenery (approximately 3600 sq. m.). A total of 50 coniferous and deciduous trees were recorded, almost all of which are in good condition, and most of which represent a high-quality basis for the future arrangement of public green areas. Landscape Unit 2 covers an area of approximately 3500 sq. m. within which 39 predominantly coniferous trees are recorded, a large percentage of which are also in good physiological condition. The grouping of cedars and Greek fir stands out. Landscape Unit 3 covers approximately 1100 sq. m. in the western part of the area. Twelve predominantly deciduous trees were recorded. In total, 162 trees and many different ornamental shrubs were recorded within the 3 mentioned units. Green areas that were once landscaped as parks are today not maintained and are difficult to access (Figure 14b).


(**a**) (**b**)

**Figure 14.** The existing high greenery—the spatial-functional backbone of the future settlement: (**a**) Valuable greenery—the three landscape units. Source: reference [82]; (**b**) High greenery in the inner courtyard. Photo by authors.

Currently, the 'TOZ' factory is managed by a bankruptcy trustee. It is minimally maintained and financed by renting out individual premises. Demolishing old buildings and freeing up land for residential construction will increase the property's value. The unexploited potential of the factory complex has been examined many times, but not a single entrepreneurial idea has been implemented. There are complicated legal and ownership relations and debts. The factory is awaiting a new owner. The factory complex will probably be demolished.

### *3.3. The Future: The Urban Development Plan*

For the future development of the 'TOZ' site, the Urban Development Plan was adopted in 2009, which defines new uses and proposes a functional and complete new residential area, with high housing density [82]. The plan is a spatial planning document created by the architectural studio 'Urbane tehnike' from Zagreb (architects: D. Plevko, Z. Krasić, H. Bakran, M. Manger, M. Androić, M. Deželić, and A. Sučić) in coordination with the City Office for Strategic Planning. The 'TOZ' site is included in the current spatial planning documentation and aligned with the higher-level plans [83], i.e., the Zagreb Masterplan.

It should be noted that the observed case study has not been assigned special recommendations for (re)construction, which would preserve the genius loci of the historical industrial area. The 'TOZ' plan envisages the demolition of the entire factory complex. Since 2009, there has been a plan to build a residential and business complex, with twenty-three multi-apartment buildings and an office tower that will dominate the surrounding area. The roads are placed orthogonally and supply all plots. Parking spaces with tree lines are included in the streets. About a hundred marked trees will be part of the green public areas of the new residential area. The site is divided into a regular grid of lots, mainly residential buildings, with approximately eight hundred apartments. A new program also comprises commercial and public facilities, sports, and recreational areas. Business, commercial, and service facilities are planned on the ground floors of residential buildings. The northeastern part is predominantly destined for mixed business use. The existing high greenery represents the spatial-functional backbone of the future settlement.

The position of the site plays a significant role. Developing the street network with communal infrastructure is a prerequisite for the growth of a new residential area. There are no utility infrastructure lines within the site. Utility infrastructure distribution lines are laid on the peripheral roads. The proximity of the railway line is the basis for evaluating the public city transport connection to the city center. Residents can also access existing

bus lines on Ilica Street through the pedestrian bridge over the railroad. A 3D city model shows the impact of planned buildings on the surroundings. The heights and shapes of future buildings can be distinguished (Figure 15).

**Figure 15.** 'TOZ' Urban Development Plan: aerial view from the southeast. Source: Freya 3D visualization. TOZ Urbane tehnike 2009 (https://www.freya.hr/3d_vizualizacija.php?p=153, accessed on 14 August 2024).

Predominantly existing low-rise residential construction is in the southeast, as well as the future sports center and kindergarten. Public parks are positioned according to the valuable trees that were found on the site. The height of multi-story dwellings is a maximum of nine floors. An office tower in the northeast can have a maximum of twenty floors. The appropriateness of tower construction is debatable both in terms of height and purpose. The positive side of the office skyscraper is that it will be a sound barrier between the railway and future buildings. The main goal was to design the city district through the preservation of natural features, the planning of the appropriate urban land use intensity, ensuring a complete urban development design, and a time-determined course of realization.

Images of the new district show a neighborhood experience with modern expressions of buildings and a mix of areas for gathering, working, and living (Figure 16).

**Figure 16.** 'TOZ' Urban Development Plan: 3D simulations of the future planned district. Source: Freya 3D visualization. TOZ Urbane 2009 (https://www.freya.hr/3d_vizualizacija.php?p=153, accessed on 14 August 2024).

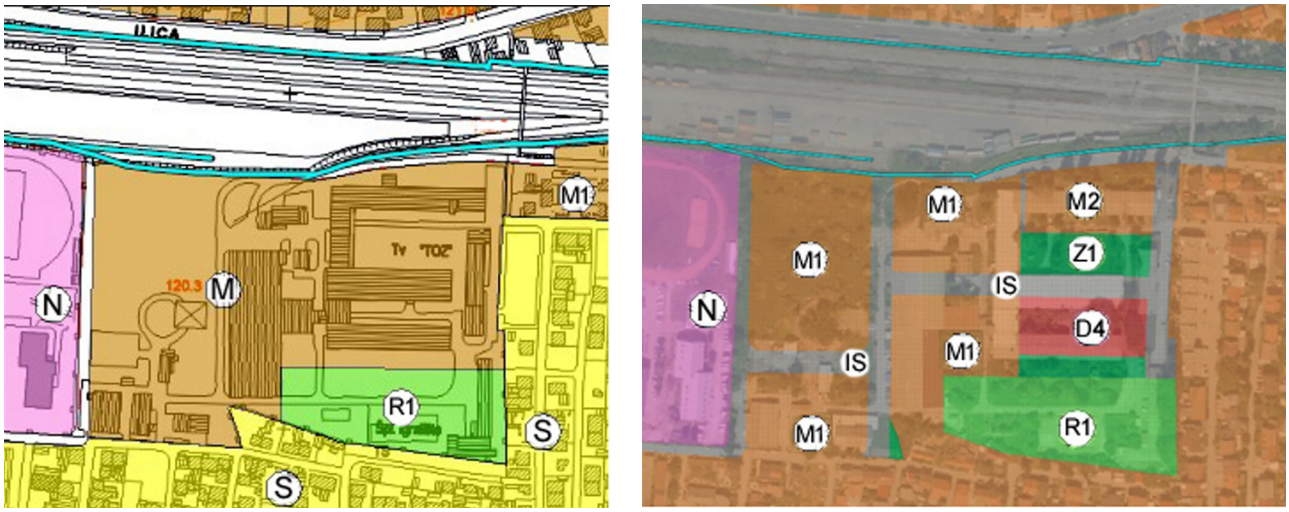
The construction of brand new buildings must be at a sufficient distance from one another across the entire area. The multi-story dwellings of different appearance with flat roofs have five, six, or seven floors with underground parking. Wide walkways and green areas dominate all the images. The only building that stands out is the office tower near the railway. The last image in a row shows the view from the pedestrian crossing over a railway corridor. The office tower will dominate the whole surrounding area. The transformation of the entire area should be followed by communal infrastructure improvement to achieve a high standard. Urban and architectural quality can be achieved through systematic and more detailed urban development.

## 4. Results

### *4.1. The 'TOZ' Site*

Field research confirmed that the 'TOZ' site was unmaintained and neglected. Research on the existing industrial construction (manufacturing plants and warehouses) indicated empty and unused industrial architecture. A comparison of the current and planned state of the 'TOZ' site indicates a comprehensive transformation of the site. The current state is abandoned, neglected, out of function, and not a protected site. The factory complex has been left to decay for almost a whole decade. The area needs improvement or restructuring.

The future state will be a densely populated and built-up district. Maps graphically show all zoning district boundaries and classifications within the site between the current and planned state (Figure 17a,b). There is a railroad and Ilica Street to the north, and a special area (military) to the west. The large mixed-use district (M) is divided into an orthogonal street grid to divide the land into regular-sized plots. The future planned state envisions a mixed-use district with housing and office space (M1 and M2), green areas—public (Z1—green), and sports facilities (R1—green). The green areas (Z1 and R1) are preserved.



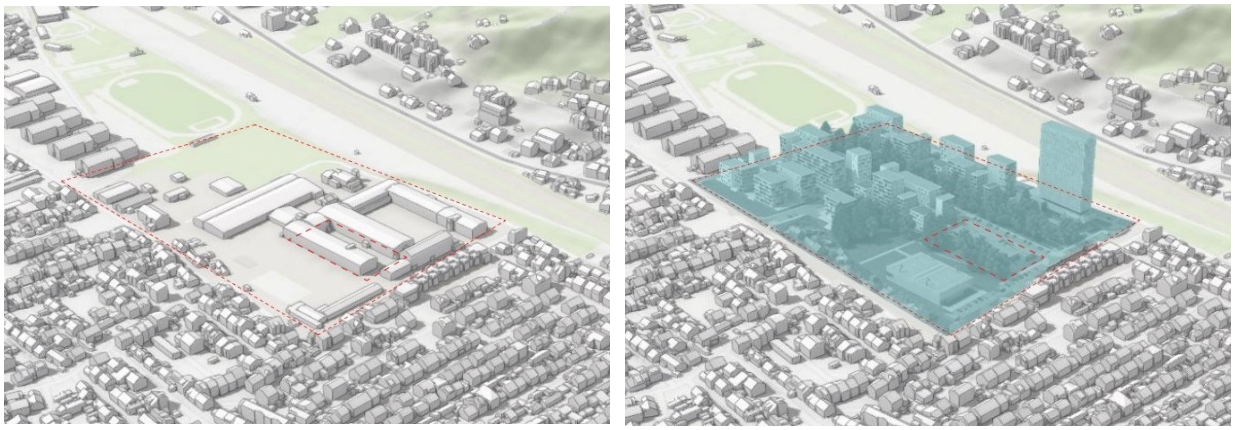

(**a**) (**b**)

**Figure 17.** Excerpt from the Zagreb Masterplan, 'TOZ' site zoning map: (**a**) Current state; (**b**) Future state—The Urban Development Plan 2009. Legend: S: residential (yellow), M: mixed-use (orange); M1: mixed-residential area (orange); M2: mixed-business area (orange); D4: kindergarten (red); R1: sports (green); Z1: public green area (green); N: special (pink); IS: infrastructure systems (white). Source: Geoportal Grad Zagreb (https://geoportal.zagreb.hr/Karta, accessed on 14 August 2024).

For business areas (unit M2), sports (unit R1), and kindergarten (unit D4), open public architectural competitions had to be organized to obtain the highest quality spatial-functional solutions. Three-dimensional views visually map the existing factory site and planned state in Figure 18a,b.

The adopted planned transformation will improve communal, economic, and social infrastructure and enable the design of a new residential and commercial city area characterized by the quality of public and green spaces.

SWOT analysis was used to anticipate how internal and external influences impact the 'TOZ' site's relation to the built environment. The transformation process of the 'TOZ' site includes both potentials (positive impacts) and constraints (negative impacts) concerning the built environment (Table 1).



(**a**) (**b**)

**Figure 18.** The current state versus the proposed reuse concept, 3D views for 'TOZ' site in Poljacka Street: (**a**) Current state; (**b**) Future state—The Urban Development Plan 2009. The kindergarten position is marked with a red dotted line. Source: ZG3D (https://zagreb.gdi.net/zg3d/, accessed on 14 August 2024).

**Table 1.** SWOT analysis results of the 'TOZ' context layout.

| **'TOZ' Site Environmental Analysis/Relation to the Built Environment** | | |
|---|---|---|
| | Strength | Weakness |
| Internal origin | - Rectangular regular plot (64.350 $m^2$)<br>- Mostly flat terrain (+120.5 m above MSL)<br>- Valuable high greenery (162 trees)<br>- An area without major roads<br>- Pedestrian access to Ilica Street/a 200 m long pedestrian bridge over a railway line (built in 1970 and refurbished 2018–2019) | - Position near the railway line/access to the plot from three sides<br>- External noise/noise reductions for occupants/protective corridors<br>- Existing outdated building construction from the 1970s (manufacturing buildings and warehouses) to be demolished and deposit<br>- Poor communal infrastructure |
| | Opportunity | Threat |
| External origin | - The possibility of road connectivity<br>- Public transport connections (bus + train line)<br>- Activation of a neglected urban space<br>- A positive impact on closely located buildings<br>- No protected industrial architecture<br>- The built environment is not subject to strict aesthetic regulations (positive impact on the architectural expression and spatial solutions) | - High population and high density of the surrounding area<br>- The low height of the surrounding buildings<br>- Lack of parking spaces in the surrounding area<br>- Poor infrastructure of the surrounding area<br>- Complex ownership relations/unsolved property–legal relations<br>- The amount of required investment |
| | ∨<br>Positive | ∨<br>Negative |

The advantages of the 'TOZ' site are its geometric regularity and low variability of elevations. The existing valorized greenery also represents a value retained and protected by the regulations of the urban development plan. The disadvantages of this site are the complex ownership and legal relations that, to date, together with the large necessary investment, are preventing the plan's implementation. By looking at the wider scope, 'external' threats can be seen in the form of surrounding construction. The houses built in the 20th century were single-story houses with attics or simple single-family houses. Although the construction is low-rise and residential, and the streets are relatively regular, and the existing transport and communal infrastructure are not satisfactory. The recent

trend of building residential buildings with several residential units (3 to 6) on the sites of small family houses made the district overcrowded and overbuilt. Streets intended for infrequent car traffic are now streets with one-sided longitudinal parking because most plots do not have the necessary parking garage spaces. Some characteristics of the area have a double effect, i.e., both positive and negative effects that make the area attractive or less attractive.

As for addressing the issues of the urban development project and the major planned objectives inside the western part of the city, the transformation project of the 'TOZ' site introduces common concepts. Natural features are going to be preserved by the integration of existing green areas in the future district site. The appropriate urban land use density will be achieved with a mixed urban typology. Site transformation is the complete urban development of a sustainable living environment. The development plan addresses the sociocultural needs of the site's users (e.g., children's parks, sports, kindergarten, etc.). As for the issue of the time-determined course of realization, the design team did not expect the TOZ project to be a long-term realization project.

The comprehensive sociological analysis and the analysis of urban transformations for the western part of Zagreb [84] suggest preserving the existing space but also giving the possibility for its everyday use. The reuse of former industrial sites can promote the transformation and interconnection of the wider urban area. Some features of industrial architecture (i.e., place of memory) can be preserved so that a combination of new and old architecture would enable new unique architectural achievements.

A thorough analysis of the 'TOZ' site's current condition addresses the decay of the existing factory structures. Limitations to the analysis that were encountered resulted from complex unknown ownership structures and unsolved property–legal relations. The research's primary limitation is the absence of an official factory owner. Consequently, data availability, site access, closed facilities, and unavailable manufacturing facilities with old machines are many further limitations encountered in this study that make the research difficult. Otherwise, the factory owners could provide access to all the required business-related data and technical documentation from factory archives. Documentation and site permission are otherwise available to the end-users (researchers) at any time. The potential limitation is the data access statement usually included in publications.

### *4.2. A Summary and Comparison of Case Studies*

Industrial sites with buildings and structures not subjected to legal preservation requirements are condemned to be demolished. Many once famous and prosperous European factories (like Tuborg, Philips, Malmar, Eternit, etc.) are now former factories. Their buildings had no heritage value and were demolished. Abandoned sites were transformed for new uses. The 'TOZ' case study is an example of the end-stage of industrial buildings, i.e., demolition. Similar transformation projects from different countries were analyzed (see Section 2.3.) to provide practical insights into how the proposed 'TOZ' redevelopment plan could be realized. Table 2 shows some key contextual characteristics of the case study sites.

The experiences of similar transformation projects provides practical and realistic examples to learn from and look up to. The comparison results of the case studies revealed many factors that influenced urban development—institutions, organizations, residents, markets, and environments. The European case studies have shown that the site's significance to a city's development (ashore, on the edge, and near the city center) is important. The demand for property and specific site characteristics influence the development process. In all the case studies, urban planning decision making is highly context-specific. The decisions and principles at the masterplan scale (planning permissions and planning context) vary between countries. Examples include the role of local planning authorities as the governing force, the importance of long-term flexibility and the architectural competition calls, developers' influences, public opposition, and the role of individuals involved in decisions. In all the case studies, the transformation project is an ongoing process that started nine to fifteen years ago. Only the Bijgaardehof transformation was

completed in 2022. Other urban development processes are still under construction (Strijp R and Eternitten) and some are expected to be completed in 2025 (Tuborg Salt Meadow). Developments at the building level with shorter timescales face less risk from changing external circumstances during the process than masterplan developments. The demolition of former factories usually makes way for new residential buildings. The site's final use is mainly residential (Tuborg Salt Meadow) and most often residential with mixed-use. Unused and abandoned former industrial areas are easily repurposed as large green spaces (parks, urban forests, tree-lined streets, gardens, etc.) to benefit urban residents. Environmental considerations and sustainability (including operational and embodied energy) are important factors (Tuborg Salt Meadow and Bijgaardehof). Today, environmental standards are a long-standing consideration in building design. The building's physical attributes were not compared. As identified in the comparison, there are more complex case studies on large former industrial sites (Eternitten) and specific reasons for which decisions (situation-dependent) are considered by developers and design teams (Tuborg Salt Meadow and Strijp R). In two examples (Bijgaardehof and Strijp R), the preservation of the factory structures was not initiated by the local authority, but by the design team. Both examples show the power of community initiatives. Some preserved structures or retained artistic parts present the industrial memory and generate cultural value for the neighborhood.

**Table 2.** Contextual characteristics of the five case study sites [30,37,38,42–46,82].

| Case Study Sites/Area (ha) | Former Function | Planning Context | Final Use | Green Areas | Sustainability | Heritage Designations |
|---|---|---|---|---|---|---|
| Tuborg Salt Meadow Copenhagen (DK)/52 ha | Tuborg brewery | New Master Planning in 2008. Expected to be completed in 2025. | 3 residential apartments buildings (84 apartments) | Communal space and large nature area | Self-sufficient Biodiversity | No |
| Bijgaardehof Ghent (B)/ 1 ha | Philips CRT television factory | Sustainability at the urban development and project levels. Urban development company and the City of Ghent. Architectural competition in 2009, completed in 2022. | Residential (59 dwellings) Co-housing Mixed-use (healthcare center) | Collective indoor and outdoor spaces | Self-sufficient Gas-free site Geothermal heat | No The preservation of the factory walls with graffiti (by the design team) generates cultural value for the district |
| Strijp R Eindhoven (NL)/ 20 ha | Malmar metal factory | No local plan was in place when developers purchased the site in 2005. Planning approved in 2010: Urban Development Plan and Spatial Quality Plan. Under construction. | Residential dwellings (600) as well as a factory, restaurant, and shops | Plenty of green spaces | High-quality living environment | No The preservation of the site's structure and the industrial memory (by designers) |
| Eternitten Aalborg (DK)/ 360 ha | Eternit cement and asbestos factory | The holistic redevelopment strategy was completed in 2006. Cooperation between developers, the City of Aalborg, and residents. Ongoing. | Residential Mixed-use Industrial area | Green spaces | Multifunctional and sustainable neighborhood | The plan is partly utilizing the former industrial buildings |
| TOZ Zagreb (CRO)/64 ha | Pencil factory | Local authority development plan in 2009. Uncertain future. | Residential (800 apartments) Mixed-use | Green areas will be preserved | | No |

### *4.3. Key Lessons Learned*

- The necessity for the complete urban and architectural transformation of the long-term neglected and aging industrial complexes as part of planning practice.
- Industrial buildings with no heritage value are/will be demolished.

- Abandoned industrial sites are transformed for new uses, mainly residential and mixed-use with large green areas.
- The origin and authenticity of the sources to ensure their accuracy and relevance were the main factors to consider when assessing the nature of historical sources.
- The availability of diverse sources that offer different viewpoints and the ability to compare multiple sources.
- The importance of incorporating urban design policies as an integral part of the development plan.
- The importance of long-term flexibility and the time-determined course of the realization of the project.
- The site's redevelopment has a strong economic and social impact on individuals and the local community identity.
- The transparency of the process and participation between all participants is the basis for the successful implementation of the future project.

## 5. Discussion

For comparative heritage management, it is important to recognize and understand the trans-cultural issues and global diversity of topics in contemporary architectural conservation. The decision of architectural intervention is predicated upon a multifaceted array of considerations. These considerations encompass technical parameters, geographical context, demographic dynamics, and market trends. The process includes a combination of philosophical underpinnings and ethical and aesthetic values interwoven with intangible heritage concepts, historical import, and collective identity [84]. For many buildings, the final step of the life cycle stages is the demolition process. The end stage of built structures is rarely part of the architect's plans. Not many buildings enjoy an 'afterlife', namely secondary or further uses to which they are put after their initially designated use is no longer relevant. For architects realizing new 'afterlives' for architectural objects, their design obligation is to approach each significant successive design stage with renewed commitments to sustainability and any other architectural standard [32].

This paper discusses a long-term vision of the 'TOZ' site transformation in the Zagreb urban area. The former factory is not recognized as a valuable piece of industrial architecture, but it is deeply embedded in the consciousness and memory of the population, because the factory, with minor interruptions, worked until 2015. The unexploited potential of the factory assembly has been reexamined many times, but not a single entrepreneurial idea has been implemented. Due to complicated legal and ownership relations and debts, the factory complex is awaiting a new owner. The transparency of the process and participation between all participants is the basis for the successful implementation of all phases of the future project, which should be a tool in the service of citizens [85].

The plan for the future urban development of 'TOZ' is a complete urban and architectural transformation to make it attractive to users. The site's redevelopment will have a strong economic and social impact on individuals and the local community. The economic impacts of this transformation will occur at different spatial scales and are likely to be both direct and indirect. Construction projects are a strong instrument of economic growth and development in local communities. The new development will benefit individual firms, residents, and the local public sector. The major impacts will be jobs, spending, and tax revenue. These impacts will occur when the housing is constructed (jobs and spending), and during occupancy. Mixed-use zoning is implemented to allow flexible zoning, which accommodates the widest possible range of activities and users. Building new mixed-use housing increases the property value. Economic revitalization in the context of both city and suburban areas has to ensure that new residential development includes affordable housing. Affordable housing can benefit local economies. In addition to the direct economic impacts of construction, the development will also bring indirect impacts. It might stimulate the wider regeneration of this part of the city, while a residential development will lead to a more favorable perception of this area. The social impact on individuals and the local

community must be assumed, as the future is unknown. In the decision-making process, local communities have to be involved to ensure that the needs and preferences of residents are taken into account. The prerequisites for fully socially integrating neighborhoods in new areas will be created with a quality building design and supporting infrastructure. The design must be flexible enough to allow for social changes and local choices. The lives of the neighborhood's residents will be improved by using the resources of the new project. The development plan addresses the sociocultural needs of the site's users (e.g., children's parks, sports, kindergarten, etc.). Residents' overall well-being will be improved by building a green and safe residential zone with adequate public space and infrastructure.

The future of the former pencil factory buildings is uncertain. It faces technical, regulatory, and financial challenges that might result in the site remaining neglected and unused for many years. The 'TOZ' urban development plan envisages the construction of a completely new residential complex with the necessary accompanying public contents. A further factor is the time for the plan's implementation. The decision-making process on the 'TOZ' site was made over a decade ago (in 2009), so it is crucial to question some other innovative solutions that would improve the surrounding area, and, in some way, give additional value to this abandoned industrial area. All these decisions work towards an assumption, namely that of what stories future societies may want to hear, and what memories will help to maintain a sense of identity [86]. Although the more likely situation is the demolition of the existing factory complex and the construction of a new residential district, a suggestion to heritage professionals is to choose in the present what physical elements of the building will assist in preserving the 'TOZ' stories for future memorial functions. The demolition of the existing industrial buildings erases historical context and every trace of the industrial complex, of which only the brand and name of the factory will remain.

For similar research in the future, it would be useful to focus on securing all required documentation and artifacts (buildings) before it is too late (while they still exist). To keep the buildings and properties empty and unused for so long is not a viable option. This paper tries to raise awareness of the industrial past and inform architects, designers, academics, and planners about the importance of design and planning decisions. The decisions of urban scale development should be taken collaboratively. Collaboration between government, local authorities, planners, and stakeholders, e.g., property managers, is necessary to prevent the long-term abandonment of industrial sites.

The findings from this micro-study want to preserve the social memory of the factory that employed the residents of surrounding neighborhoods. Reuse planning is a community-based process, so future site transformation projects must find ways to increase community participation in reuse strategies to make end users' wishes and demands clear. More attention should be paid to flexibility and time-based programs. The urban development process with the long timescale of masterplans makes their economic viability more vulnerable to changing market conditions. A building-level development with a shorter timescale faces comparatively less risk from changing external circumstances during the process than masterplan developments.

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