

# **Industrial Brownfields as Restorative Environments: the Possibility of Transformation and Reactivation of the Abandoned Industrial Heritage**

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## **1 ABSTRACT**

Changes in the needs of modern society, as well as technical and technological developments, have led to an increase in the number of abandoned industrial buildings in cities, thereby disrupting existing urban areas. Although in recent decades the well-known practice of urban revitalization of abandoned industrial heritage buildings has been recognized as a successful method for urban revival, these types of properties in Serbia, although being the former symbols of prosperity and the power of the state, have been left to physical decay.

Restorative environments, unlike industrial heritage buildings, are designed to contribute to the health and well-being of people, especially by alleviating mental fatigue and stress, through the people's contact with nature. As restorative environments are predominantly tied to open spaces and natural settings, it is important to consider the possibility of applying this concept to indoor environments.

The aim of this paper is to research the possibility of applying the principles of restorative environments in the processes of transformation and reactivation of abandoned industrial heritage buildings, which have been placed under state protection as cultural monuments.

Through an extensive literature review, including different theoretical concepts and analysis of good practices, this paper examines the possibilities of transformation and reactivation of the abandoned industrial heritage on the territory of Belgrade such as Sugar Plant, the Milan Vapa's Paper Mill and the Power and Thermal Power Station "Power and Light", through the implementation of the concept of restorative environments.

The aim of this paper is to examine the possibility of transforming abandoned industrial heritage into healthy environments while adding cultural, social, and economic value. Application of this concept could lead to the formation of new potential for increasing public health within the urban tissue, as a new form of a public good, as well as to consider the possibility of wider use of restorative environments.

Keywords: urban renewal, industrial heritage, reactivation, restorative environments, Belgrade

## **2 INTRODUCTION**

The transition of society from industrial to post-industrial and the accelerated urbanization that led to the expansion of cities, influenced the change in the character of industrial locations that were once planned on the peripheral parts of the cities, along with strategic traffic routes. These locations have become abandoned parts of the wider central zone of cities, occupying significant areas of building land intended for construction. Considering the importance of industrial buildings and complexes in general, both through their cultural and historical value, bearing in mind that they represent a testimony to the development of society not only through the construction of industrial buildings but also through the construction of supporting infrastructure systems and are part of society's collective memory, many industrial buildings and complexes have been revitalized in Europe in recent decades.

Due to the current underdeveloped practice of including such buildings in the socio-economic development of society, the topic of the revitalization of industrial heritage in Serbia is of particular importance. Numerous industrial buildings in Serbia have been left to decay, which has neglected their cultural and historical significance. Belgrade has significant and numerous industrial buildings with recorded cultural and historical value and their position and character represent a good basis for the development of various purposes. Many of these industrial buildings and complexes are positioned in locations that are intended for the development of commercial activities, and therefore, their valorization and preservation are under great pressure from potential investors.

Taking into account the challenges that cities face today and that the issue of sustainability and improving the health of people in cities is one of the most important issues for all professions, not just for urban planners, finding the new ways to plan restorative environments could contribute to better understanding and improving public health in cities.

Unlike industrial buildings, which are most often associated with impaired human health, restorative environments are spaces that contribute to the health and well-being of people. The contribution of restorative environments to human health and well-being is reflected especially through the alleviation of mental fatigue and stress, through people's contact with nature. Exposure to the natural environment reduces negative behaviors and conditions such as aggression, anxiety, depression, or other types of illness, and increases the positive aspects such as health, cognitive abilities, etc. (Mayer, Frantz, Bruehlman-Senecal & Dolliver, 2009). The visual presence of plants can be one of the stress-reducing factors, considering that affective responses to aesthetic visual stimuli can reduce tension levels in humans (Grinde & Patil, 2009).

In addition to natural environments, built environments may have certain characteristics of restorative environments (Kaplan & Kaplan, 1989). However, the degree of restorativeness can be increased by including nature in the context of the built environment. Place attachments also could lead to positive emotional changes (Korpela, 1989), which increase the level of restorative experiences.

Having in mind the stated characteristics of industrial buildings and complexes, but also the characteristics of restorative environments, this paper examines the possibilities of applying the characteristics of restorative environments in the processes of transformation and reactivation of abandoned industrial heritage buildings on the territory of Belgrade. The criteria for the selection of industrial buildings and complexes discussed in the paper are that: these buildings are under state protection as cultural monuments, and thus part of the collective memory, which indicates their importance and increases the propensity of people to these buildings and complexes; they are intended for commercial activities by urban planning documents, and thus their preservation is under great pressure, which requires finding sustainable and cost-effective solutions; and that these buildings are parts of the significant natural environments, which would potentially increase the restorative effects. Also, a common feature of all selected objects of industrial heritage is that their locations, by their nature, are in close proximity to natural environments (rivers and other natural environments that have special significance, quality, and potential for creating restorative environments) but are not directly related to them, which especially points to the problem of connection and the need to create new unique units.

By researching the application of restorative principles on the abandoned industrial heritage such as Sugar Plant, the Milan Vapa's Paper Mill and the Power and Thermal Power Station "Power and Light", the aim of this paper is to examine the possibility of transforming abandoned industrial heritage into healthy environments with cultural, social, and economic value.

### **3 THE CONCEPT AND SIGNIFICANCE OF THE RESTORATIVE ENVIRONMENTS**

#### **3.1 Restorative environments and importance of nature**

Restorative environments refer to the ability of nature to induce the improvement of cognitive abilities and the reduction of stress caused by people's daily activities and exposure to stressful environmental influences, explained by the Attention Restoration Theory (Kaplan & Kaplan, 1989) and the Stress Reduction Theory (Ulrich, 1983).

By researching and evaluating people's preferences for different types of landscapes, it has been found that people are much more inclined to build environments with natural elements such as plants, water, etc. than environments without these natural elements (Kaplan & Kaplan, 1989). This preference is explained by the biophilia hypothesis. Biophilia (Wilson, 1984) is defined as a genetically-based human need and propensity of humans to connect with nature and natural processes.

The relationship between nature and man usually involves direct contact with natural elements such as daylight, fresh air, plants, etc. (Ramzy, 2015). People's connection with nature, both direct or indirect, have a significant impact on human health (Kahn, Severson & Ruckert, 2009; Mayer et al., 2009; Maas, Verheij, Groenewegen, de Vries & Spreeuwenberg, 2006; de Vries, Verheij, Groenewegen & Spreeuwenberg, 2003; Wendelboe-Nelson, Kelly, Kennedy & Cherrie, 2019). The visual presence of plants may be one of the

stress-reducing factors because affective responses to aesthetic visual stimuli can reduce tension levels in humans (Grinde & Patil, 2009). Taking into account the positive effects they cause in humans, which is primarily related to reducing stress, improving mental engagement and attention (Biederman & Vessel, 2006), as well as emotions, moods, and attitudes (Barton & Pretty, 2010), natural environments can be good platforms in environmental strategies for creating restorative environments or environments without stress.

### 3.2 Restorative environments as built and interior environments

Kaplan and Kaplan (1989) indicate that nature and natural elements cannot be clearly defined and that places or things that are natural are the ones which we have experienced. Keeping this in mind, restorative environments do not necessarily relate to a single typology of environments, in this case, nature, but also built environments (Scopelliti, Carrus & Bonaiuto, 2019). If the specific properties of the natural environment make such an environment restorative, then built environments with similar or the same properties could contribute to people as a kind of restorative environments (Scopelliti et al., 2019).

As the Scopelliti et al. (2019) states, conducted studies dealing with the research of restorative built environments exist in small numbers, and according to the character of the objects, they usually include objects that have a certain artistic or historical value. This can be specifically connected to the aspect of collective memory and the sense of belonging and connection that an individual has towards a certain object or built environment in general.

As visual perception plays an important role in the processes of restorativeness, it is important to consider the ways and mechanisms to contribute to people's health in a built environment in the same way that nature contributes. People react very similarly to the natural environment, whether it is real or virtual (Benjamin, 2013). Simulation of nature, through the artistic representation of nature, virtual reality, and other illusions, can be as important as real nature, primarily due to the visual aspect, which positively affects human health. Therefore, it is important to consider the manner of application of digital nature in built environments or in the interior of buildings, especially through the processes of the revitalization of existing buildings. Downton, Jones, Zeunert and Roös (2017) pointed out that generating a virtual experience, in places where it is not possible to make real contact with nature, can have a positive impact on people's mental health and well-being. Making contact with digital nature can be categorized as an advantage when it is impossible to make real contact with nature.

Kahn et al. (2009) point out that, even with comprehensive technological progress, the identity of digital nature and real nature, from the aspect of their positive effects on humans, is the subject of various researches and debates. Human exposure to digital nature provides some but not all of the pleasures and benefits as contact with real nature does (Kahn et al., 2009), so digital nature should thus be treated as a significant element that could improve human health when exposure to real nature is not possible or when it is minimized.

## 4 INDUSTRIAL BROWNFIELDS AS RESTORATIVE ENVIRONMENTS

### 4.1 Transformation and reactivation of abandoned industrial heritage buildings

As the restoration processes are a consequence of the comprehensive experience of space and the connection that people make with that space, the purpose of the space and the activities that take place in it plays an important role. Having in mind the cultural and historical significance of industrial heritage buildings and an important position in the modern urban fabric, the revitalization of these buildings is a significant strategic commitment that could meet the modern needs of society but also adequately protect industrial heritage. Revitalization of industrial heritage buildings should include a modern context and development trends and thus integrate modern functions. This can lead to the connection of modern society with revitalized industrial heritage as their favorite place, which would also lead to an increase of the restorative potentials of the space.

The social component is especially important, so environments that increase social interaction are more important from the aspect of the feeling of security, accelerating the processes of restorativeness (Staats & Hartig, 2004). Social relations can be constituted through space, constrained by space, or mediated by space (Dear & Wolch, 1989). Human behavior is related to situations or contexts that are not only part of physical settings, but also perceptual, cultural, and social (Carmona, Tiesdell, Heath & Oc, 2003).

Due to the complexity of all the above characteristics that define space and affect a person in a way that improves his health, during revitalization, it is desirable to take into account all the complex relationships. Therefore, the formation of such spaces could provide continuous development of the intervention area, as well as the possibility for constant use of facilities by different social groups. Such spaces, by their multifunctional character, should correspond to the character of the narrower and wider context in which they are located, which would achieve a balance between the needs of different actors in the revitalization processes. Also, the specificity of the content itself plays an important role in attracting users.

Scopelliti et al. (2019) pointed out studies (Scopelliti et al., 2016; Carrus et al., 2017; Amicone et al., 2018) which explore the restorative potentials of places through on-site experiences in urban parks, botanical gardens and educational settings. As natural environments in themselves are not a sufficient factor for achieving economic profitability and sustainability of revitalization of industrial heritage, it is important to fit them into other contents, creating a mixed-use. In order to achieve the socio-cultural revitalization of industrial heritage, it is necessary to implement a strategic approach that would achieve an attractive and modern redesign of buildings, but also locate recreational, cultural and educational content, and create spaces potentially intended for various events and tourism presentation. Combining spaces dedicated to social interaction and creative production could have positive effects on the development of social and economic capital.

The revitalization of the presented objects of industrial heritage should be adjusted to the cultural, historical, but also social and political circumstances of the environment. Although recreational, cultural, scientific and artistic activities that bring together different social categories of people, increasing the degree of socialization, can increase opportunities for creating a restorative environment, revitalization of these facilities significantly depends on economic stability and sustainability of all projects and planned facilities.

## 4.2 The Sugar Plant

The complex of the Sugar Plant, as the first of that kind in Belgrade, was built in 1899-1901. The factory complex contained not only buildings intended for production processes but also housing buildings intended for employees (Dimitrijević-Marković & Sretenović, 2008). Various reconstructions that were carried out within the factory complex, and which took place most intensively between 1923 and 1946, led to the creation of a mixed architectural and functional value of buildings within the complex (Dimitrijević-Marković & Sretenović, 2008). At the moment, the Sugar Plant complex is mostly a devastated and abandoned area, with a minimal functional degree of activity. Dimitrijević-Marković and Sretenović (2008) state that, except for the machine-room in which the KPGT theater is located, the common characteristic of all buildings in the complex is that they have purposes that are not adequate, accompanied by general lack of maintenance and thus deterioration of buildings.

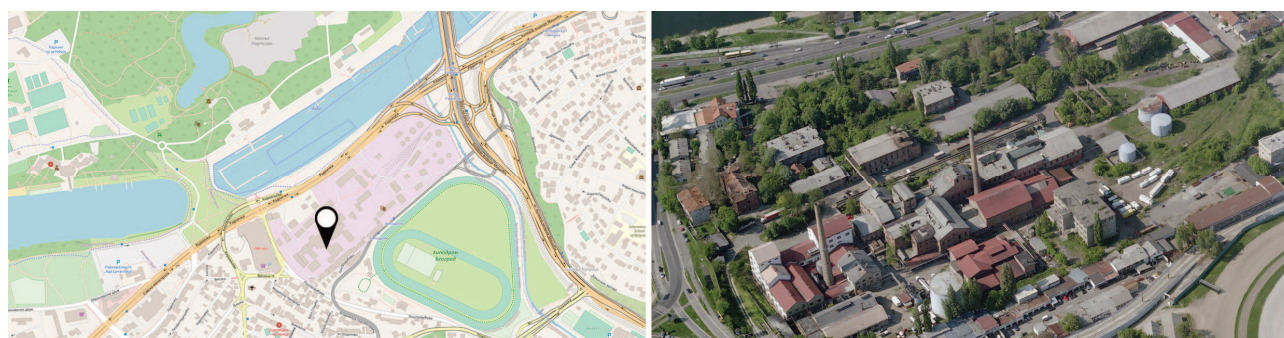


Fig. 1: The position of the Sugar Plant in relation to the immediate environment (left) and the aerial view (right).

A machine-room, drying-room, employee quarters and a house for the workers and the building of the directorate, as the oldest buildings and buildings of exceptional architectural and cultural-historical value, are standard examples of industrial architecture from the end of the 19th century in northern and central Europe (Dimitrijević-Marković & Sretenović, 2008). The residential building for workers stood out for its stylistic characteristics in relation to the other listed buildings, with its monumentality but also the absence of facade decoration, and today its authenticity has been degraded by various changes in both interior and exterior (Dimitrijević-Marković & Sretenović, 2008). Due to its dimensions and extremely high chimney, the spatial dominant of the complex is the machine-room.

The complex of the Sugar Plant is located along the banks of the Sava River, near the urbanized Ada Ciganlija and the protected Ada Medjica, important components of the natural core of Belgrade, which have natural values important for preserving the quality of the environment and recreational areas of the city. In addition to the above, the complex of the Sugar Plant is located in the immediate vicinity of the natural monument "Topčiderski Park", which has been placed under state protection due to its natural, cultural-historical and landscape values. Although the complex of the Sugar Plant is located next to extremely important natural environments, their connection is not adequately spatially defined and realized. With the river Sava, Ada Ciganlija and Ada Medjica the complex of the Sugar Plant is separated by Radnička Street, a road with high traffic intensity, while the tram line, which is spatially defined so that it passes directly along the southern border of the complex, separates it from Topčider Park. In the immediate vicinity of the Sugar Plant complex, there are locations intended for commercial facilities. One of them is the location on the northeast side of the Sugar Plant complex, planned for the commercial activities and city centers. Along the western border of the Sugar Plant is the newly built Ada mall. The complex of the Sugar Plant is also in the immediate vicinity of the Belgrade Fair - a meeting place for actors belonging to different areas and industries, through events of international and regional character. The diversity of content in the immediate vicinity of the Sugar Factory complex, which attracts various members of socio-economic groups, makes this location an additional attractive and potential place that, with adequate revitalization, could become a gathering place for these actors.

### 4.3 The Milan Vapa's Paper Mill

The Milan Vapa's Paper Mill was designed by architect Karl Hanisch and built-in 1921–24. The development of the Serbian economy in this period was significantly contributed by the construction of this factory, which at that time belonged to the category of large and modern industrial companies that can compete with factories of this type located in developed European countries (Mihajlov, 2010). Due to its cultural, historical, architectural, and urban values, the Milan Vapa's Paper Mill has the status of a cultural monument. Mihajlov (2010) states that The Milan Vapa's Paper Mill from the urban aspect testifies to the existence of one of the first extremely important zones intended for the industry in Belgrade, while its representativeness indicates the importance of an architectural design of industrial buildings in that period. After the cessation of paper production during the 1950s and the relocation of the factory to another location, the factory building was converted into a business facility.



Fig. 2: The position of the Milan Vapa's Paper Mill in relation to the immediate environment (left) and the aerial view (right).

It had its own industrial railway and a quay for berths for ships and barges on the banks of the Sava. The Milan Vapa's Paper Mill is architecturally shaped in the spirit of academism modified according to the function of the building itself, and its interior is designed according to the technical and technological requirements of production processes on an area of about 3,600 square meters (Mihajlov, 2010). Special importance in the design of the building has a chimney, which is the dominant element of the building.

The Milan Vapa's Paper Mill is located next to several important hubs of a different character. The factory complex is located along the Sava River, in the immediate vicinity of Ada Ciganlija and Ada Medjica, a dynamic and unique ecosystem and the central natural core of Belgrade. Although it is located in the immediate vicinity of the river, the factory complex does not have a completely clearly defined connection with it. The Milan Vapa's Paper Mill borders the Belgrade Fair complex on the west side. Within the Belgrade Fair, numerous state, regional and international events are organized, but also other events that attract a large number of participants, which is one of the potentials for the development and reactivation of

the factory complex. In the immediate vicinity of the Milan Vapa's Paper Mill is also the building of the Belgrade Publishing Institute (BIGZ), a significant architectural achievement of Yugoslav modernity and a reference point of space. It was built between 1934 and 1941 and is under state protection as a cultural monument. Although BIGZ has lost its original purpose, in the last few years a large number of young artists, designers, architects, musicians, but also several companies have moved into the building. The location is bordered by important traffic routes and facilities (Prokop railway station). All these characteristics, but also the contents of the immediate environment, represent an important potential for the development of the factory itself.

#### 4.4 The Power and Thermal Power Station "Power and Light"

The complex of the Thermal Power Station "Power and Light" was built between 1930 and 1932, by the Swiss Basel-based Electrification and Transport Society. The Thermal Power Station complex consists of several buildings: the main cubic power station building, the portal crane, the pumping station, and the water filtering plant. The main building has three functional units, which are visible in terms of construction and design: the boiler room, machine hall, and control room (Mihajlov, 2011). The Thermal Power Station has been out of function since 1969. Due to its cultural and historical values, but also values in the architectural and urban sense, the Thermal Power Station "Power and Light" has the status of a cultural monument.



Fig. 3: The position of the Thermal Power Station in relation to the immediate environment (left) and the aerial view (right).

The significance that the Thermal Power Station building had in the period of its creation can be seen through the architectural, technical, but also an economic aspect. Evidence of the rise of society, through all the above aspects, makes the Thermal Power Station significant in the modern context also. At the time of construction, the Thermal Power Station was the largest facility of its kind in Belgrade (Mihajlov, 2011).

The building of the Thermal Power Station is designed according to the properties and principles of modern architecture and is characterized by its simplicity of form, and also the rationality of spatial organization. As Knežević (2007) states, social norms related to the creation of humane working conditions, through the establishment of a more pleasant working environment, were achieved by opening the building to the outside, using large glass surfaces, which not only struck a balance in the massiveness and monotony of the building but also in a way abolished the boundary between the interior and exterior of the building.

The Thermal Power Station is located in an urban location along the Danube, in the immediate vicinity of the Marina "Dorcol". Although it is insufficiently arranged at the moment, the location of the Thermal Power Station building has great urban potential. The proximity of the location in relation to the planned metro route, but also the fact that it belongs to the scope of the detailed regulation plan for the construction of the line park, make this location even more attractive. The line park, which includes the Thermal Power Station complex, is planned in the length of 4600 m, connecting the Concrete Hall and the Pancevo Bridge. These development and urban potentials of the location, as well as the planned capital city projects in its immediate surroundings, represent the backbone of the development of the location itself, but also a challenge for its preservation and reactivation. The environment of the Thermal Power Station consists of numerous other industrial buildings, which should be activated, as well as the building of the Thermal Power Station. Current activities and attractions of the city population in this area are based on holding various cultural events. Therefore, the revitalization of the Thermal Power Station itself should be viewed through the creation of a hybrid model, which would reuse its potentials for artistic, scientific, and cultural purposes (Knežević, 2007).

## 5 CONCLUSION

The industrial development of Belgrade influenced the spatial and urban development of the city. As the industry progressed with constant technological changes, so did the needs of certain factories, and certain plants even shut down completely. With the development and expansion of the city, but also with the abolition or relocation of production processes of certain factories, once developed industrial zones, formed on the peripheral parts of cities, became devastated and abandoned places within the wider central core. Insufficient utilization of architectural and urban potentials of these locations has the consequence of their separation from the spatial context in which they are located. The objects of industrial heritage have an exceptional cultural-historical and monumental value and are a testimony to the development of the city and the aspirations towards the economic progress of both Belgrade and the entire country. For these reasons, the protection of these buildings is very important.

At the end of the 20th and the beginning of the 21st century, the trend of the revitalization of industrial facilities began, which were reactivated by the introduction of new contents of educational, cultural, or artistic character. Ideas about industrial facilities and complexes are most often related to the economic progress of the country, but also to the negative attitude towards the natural environment. As the objects of industrial heritage are not in function, their revitalization through the creation of a connection with nature, but also the shaping and rectification through the principles of restorativeness, could have a positive impact on the improvement of public health. In that case, the objects of industrial heritage would be restorative points or points that encourage the improvement of psychophysical and social health in cities.

Restorative potentials of space can be related to natural environments, but also to the restorative potentials of the built environment as a whole, although through the literature this topic is still insufficiently researched. The restorativeness of the built environment is related to its various characteristics. Spaces that are part of the collective memory, such as buildings that have significant artistic and cultural-historical value, have special restorative potentials. These objects are significant because of the sense of belonging that individuals have in relation to these objects. The restorativeness of the space also depends on the visual perception of the user, so it is of great importance to design these spaces in a way that provides a sense of security and comfort for the users. When it comes to visual perception and nature in the built environment, in places where it is not possible to introduce natural elements or make real contact with nature, it is possible to use digital representations of nature, bearing in mind that they have the same or similar positive effects on human health, as well as contact with real nature. Therefore, it is important to consider the use of modern digital technologies in the processes of the revitalization of industrial heritage, which would simulate natural processes and elements. Also, a particularly important aspect in the revitalization of industrial heritage is the creation of places that encourage social interaction of people, through the introduction of attractive content, attracting different socio-economic groups and enabling the use of space in different periods on a daily, monthly and annual basis.

All three industrial heritage complexes have significant architectural, urban, and cultural-historical value. They are located next to significant natural cores in the city, but due to spatial limitations, they are not clearly connected with the natural environment. Having in mind the importance of nature for the psychophysical and social health of people, connecting the complex of industrial heritage with the natural context in which they are is recognized as important and necessary. Also, these facilities have great potential for creating new hubs for gathering different social groups, bearing in mind that they are located in the immediate vicinity of various recreational, commercial, and business zones.

Revitalization of these industrial heritage buildings should include a modern context and development trends, and it should be adjusted to the cultural, historical, social, and political circumstances of the environment also. They should have economic value and cost-effectiveness, not only recreational, cultural, scientific and artistic activities that bring together different social categories of people, and to achieve a balance between the needs of different actors in the revitalization processes.

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## 7 ILLUSTRATIONS

Fig. 1: The position of the Sugar Plant in relation to the immediate environment (left) and the aerial view (right). Retrieved June 08, 2020, from [www.openstreetmap.org](http://www.openstreetmap.org) (left) and [www.bing.com](http://www.bing.com) (right).

Fig. 2: The position of the Milan Vapa's Paper Mill in relation to the immediate environment (left) and the aerial view (right). Retrieved June 08, 2020, from [www.openstreetmap.org](http://www.openstreetmap.org) (left) and [www.bing.com](http://www.bing.com) (right).

Fig. 3: The position of the Thermal Power Station in relation to the immediate environment (left) and the aerial view (right). Retrieved June 08, 2020, from [www.openstreetmap.org](http://www.openstreetmap.org) (left) and [www.bing.com](http://www.bing.com) (right).