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Examined in Theory—Applicable in Practice: Potentials of Sustainable Industrial Heritage Conservation in a Contemporary Context—The Case of Belgrade

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Abstract: The industrial heritage of the city of Belgrade is the focus of this research, which highlights the possibilities of preserving industrial heritage from the perspective of a contemporary context and sustainable development. Guided by theoretical principles on the preservation of cultural and industrial heritage, their values, authenticity and spirit of place, as well as the idea of the necessity of integrating industrial heritage into the contemporary context, this paper aims to examine the possibilities for the preservation of industrial heritage following theoretically established principles, with the introduction of new uses and sustainable solutions. The analysis of the case studies of Belgrade's industrial heritage presented in this paper results from research conducted by the teachers, associates and students of the University of Belgrade, Faculty of Architecture. The research focuses on the possibilities of translating the principles of preserving cultural and industrial heritage from their theoretical definition to practical application. The students' conceptual solutions for protection, revitalisation and presentation of the analysed case studies represent the research results. An important aspect of this paper is defining the criteria for valorising students' conceptual solutions, which are aligned with the principles of preserving cultural heritage and establishing sustainable development. The valorisation of students' conceptual solutions through a defined set of criteria indicates real possibilities for the simultaneous preservation of all the values of industrial heritage and its transformation into a social, ecological and economic resource of the contemporary city.



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Keywords: principles of heritage preservation; industrial heritage; values; authenticity; the spirit of place; integration; contemporary context; sustainable development; criteria for valorisation

1. Introduction

Even though industrial heritage is the focus of this research paper, in order to better understand its values, principles of preservation and the possibility of its integration in accordance with the contemporary context and sustainable development, it is necessary to first look at the meaning and significance of cultural heritage within which industrial heritage is a typology. The phenomenon of cultural heritage and the development of ideas concerning the importance of its preservation began in the 19th century, with the works of authors from the field of conservation theory, among whom William Morris's *The Manifesto of The Society for the Protection of Ancient Buildings* and *The Seven Lamps of Architecture* from John Ruskin stand out [1,2]. A special contribution to the preservation of cultural heritage as a testimony to future generations was provided by Alois Riegl, emphasising that “a monument is a work of man erected for the specific purpose of keeping particular human deeds or destinies (or a complex accumulation thereof) alive and present in the consciousness of future generations” [3] (p. 69). However, the development of the cultural heritage preservation field at a global level began in the 20th century after the Second World War, with the establishment of internationally recognised organisations aimed precisely at the study of world heritage. Among them are the International Council on Monuments

and Sites (ICOMOS), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Center for the Study of the Preservation and Restoration of Cultural Property (ICCROM), Council of Europe, which the author Nikolić points out in his research [4]. The documents verified by these organisations provided important definitions of the term heritage and a set of principles for its preservation, which are still relevant and indispensable starting points for heritage research. Also, globally recognised charters, declarations, conventions and recommendations represent an attempt to translate the theoretical thought about the importance of cultural heritage preservation into its practical application in the process of cultural heritage restoration in the contemporary context. The analysis of the most important documents in the continuation of this paper gives us a better insight into the definition of heritage and its values. It also points to essential principles of heritage preservation and possibilities for their implementation in practice.

1.1. Cultural Heritage and the Analysis of Relevant Documents

With the First International Congress of Architects and Technicians of Historic Monuments held in Athens in 1931, general principles in the field of cultural heritage preservation related to the protection of monuments were set. Through the so-called *Carta del Restauro* adopted in 1931, seven main resolutions were defined, the implementation of which would be crucial for developing the field of cultural heritage preservation in the 20th century. *The Athens Charter* from 1931 became the driving force for the formation of international organisations in the field of cultural heritage preservation (Paragraph I), defining appropriate measures for the protection of cultural heritage through the application of conservation and restoration (Paragraphs II, IV, V), but also for the consideration of the importance of preserving cultural heritage from the global to the local level (Paragraph III, VI, VII) [5]. On the other hand, only with the verification of *The Venice Charter* in 1964 was a more explicit coverage of cultural heritage given through the definition of the historic monuments (Article 1) and guidelines for their preservation through the application of conservation (Articles 4–8) and restoration (Articles 9–13) [6]. The importance of viewing “ancient monuments as a common heritage” [6] (p. 1) and their preservation “for future generations” [6] (p. 1) is particularly emphasised, which indicates not only cultural–historical, architectural or aesthetic monument values, but also human values as equally important. However, the first definition that directly determines the scope of cultural heritage was given in the *Convention Concerning the Protection of the World Cultural and Natural Heritage* framework in 1972. According to the Convention, the existence of cultural and natural heritage was recognised, and within the framework of cultural heritage, monuments, groups of buildings and sites were defined [7] (Article 1). Given that the Convention made the first division of heritage into cultural and natural, as well as that “the outstanding universal value” [7] (Articles 1–2) is highlighted within the definitions of the scope of these categories of heritage, the question of the value of cultural heritage and its relationship with the natural environment was raised. The question of value becomes the focus of further research in the field of cultural heritage preservation and the adoption of internationally recognised documents.

1.1.1. Cultural Heritage and the Question of Its Values

Within the *Recommendation considering the safeguarding and contemporary role of historic areas*, defined in 1976, in addition to the recognised cultural, social, architectural and historic values of cultural heritage, the importance of property value and market/rental value is highlighted [8] (Paragraphs 12, 33, 38). Recognising these typologies of values raises the issue of integrating and using cultural heritage in the contemporary context in a way that responds to the needs of the local community and the place where it is located. *The Burra Charter*, verified in 1979, is particularly important for understanding the value of cultural heritage and its significance, within which “cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations” [9] (Article 1). In its later version from 2013, in addition to those mentioned above, it is emphasised that

cultural significance is “embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects” [10] (Article 1, Paragraph 1.2). The importance of cultural heritage understood in this way indicates the necessity of preserving all its values, which are not only related to the protection of tangible aspects of cultural heritage but also of intangible ones, connected with people. That cultural heritage is inseparable from people is also confirmed through the *Convention for the Protection of the Architectural Heritage of Europe* from 1985, within which the importance of fostering “public awareness of the value of conserving the architectural heritage” is indicated [11] (Article 15, Paragraph 1) through appropriate education and the promotion of cultural heritage values.

However, the official recognition of intangible aspects of cultural heritage at the global level was achieved only in 2003, with the verification of the *Convention for the Safeguarding of the Intangible Cultural Heritage*. According to the definition, the intangible cultural heritage “means the practices, representations, expressions, knowledge, skills—as well as the instruments, objects, artefacts and cultural spaces associated therewith—that communities, groups and, in some cases, individuals recognise as part of their cultural heritage” [12] (Article 2, Paragraph 1). Within the framework of the Convention, the changeability of intangible cultural heritage is particularly emphasised, which is conditioned by the context in which it exists and the people who modify it over time; also, the importance of preserving and passing on intangible cultural heritage to future generations as part of their identity is highlighted. The great importance of the Convention is reflected in the definition of a set of guidelines for the preservation of intangible cultural heritage at the local and international levels, as well as through highlighting the education and participation of local communities, groups and individuals in the processes of preservation of intangible cultural heritage [12] (Paragraphs 11–18). The inclusion of local communities in the processes of preserving cultural heritage is the focus of the *Convention on the Value of Cultural Heritage for Society* from 2005, which also recognises a particular type of community—“heritage community” [13] (Article 2, Paragraph b)—aimed at nurturing the values of cultural heritage and preserving them for future generations.

Although the previously presented documents indicate the complexity of the cultural heritage phenomenon, its values, the relationship between cultural heritage, context and people, the most comprehensive interpretation of cultural heritage is provided within *The Québec Declaration on the Preservation of the Spirit of the Place*, verified in 2008. Through the definition of the spirit of the place “as the tangible (buildings, sites, landscapes, routes, objects) and the intangible elements (memories, narratives, written documents, rituals, festivals, traditional knowledge, values, textures, colors, odors, etc.), that is to say, the physical and the spiritual elements that give meaning, value, emotion and mystery to place” [14] (p. 2), it is possible to see cultural heritage as a set of tangible and intangible elements that are in a dynamic relationship of change with the environment in which they are located and with the people who modify them over time. By defining the spirit of the place, a step forward in the interpretation of the cultural heritage was encouraged, from the previous static material remnant of the past towards a “living” dynamic and changing cultural heritage that should be an integral part of the context in which it is located, and that should reflect the values of the time in which it exists.

1.1.2. Cultural Heritage and the Question of Its Authenticity

A change in the interpretation of cultural heritage from static to dynamic, i.e., changeable over time, raised the question of understanding its authenticity. The concept of authenticity was defined in 1994 in *The Nara Document on Authenticity*, based on the premise that preserving cultural heritage implies preserving all its values throughout the various periods of its duration. Special focus is on relevance, i.e., the authenticity of the source of information, of which the study enables learning about the cultural heritage and its values. In this regard, authenticity is interpreted “as the essential qualifying factor concerning values” [15] (Paragraph 10). Defined in this way, the notion of authenticity becomes the determinant by which a monument, group of objects or site is determined as cultural

heritage. In the *Operational Guidelines for the Implementation of the World Heritage Convention* from 2005, a list of information sources was established to determine the authenticity of cultural heritage [16] (Paragraph 82). Jokilehto et al., in their study from 2008, further developed this list into “three main headings: (a) creative-artistic authenticity, (b) historical-material authenticity, and (c) social-cultural authenticity” [17] (p. 43). The fulfilment of the aforementioned authenticity criteria implies the preservation of the authenticity of the material, form and purpose of cultural heritage, as the author Nikolić points out in his work [4].

Studying the authenticity of cultural heritage is also significant in determining “the outstanding universal value of the cultural heritage”, based on which a particular monument, group of objects or site qualifies for Unesco’s *World Heritage List* [18], thus confirming their global importance. Although the definition of the term “the outstanding universal value” is missing, it is interpreted, like the authenticity of cultural heritage, through a set of six criteria that are used to analyse the following: exceptional artistic or aesthetic achievement, excellence in witnessing a vanished civilisation or a civilisation in development, excellence in construction and technical–technological achievements, excellence in the presentation of lifestyles, beliefs, ideas, as well as excellence in the exchange of human values [19]. Like cultural heritage, the criteria for determining “the outstanding universal value” are conditioned by the context in which the cultural heritage is located; they are dynamic and have undergone certain modifications over time, as shown in the work of the author Vahtikari [20].

In addition to the concept of authenticity, integrity plays an important role in researching cultural heritage and its values. It represents “a measure of the wholeness and intactness of the natural and/or cultural heritage and its attributes” [16] (Paragraph 88). Concerning the concept of authenticity, which fosters the preservation of all values of cultural heritage created in different historical periods of its duration, the definition of the concept of integrity is often interpreted as the preservation of the original state of cultural heritage, which does not represent its adequate understanding. In contrast, the concept of integrity should be seen as “a measure of the wholeness and intactness of the elements that together form a reference for its importance” [21] (p. 15). While the concept of authenticity is related to the credibility of the source of information about the cultural heritage that needs to be preserved, the concept of integrity indicates the credibility of the cultural heritage in situ. Viewed in this way, the notions of authenticity and integrity of cultural heritage are complementary, with the common goal of shedding light on the credibility of cultural heritage over time by studying available sources of information and searching for their tangible and intangible fragments in space. Research on the authenticity and integrity of cultural heritage is a prerequisite for preserving its tangible and intangible values, but also for considering the possibility of integrating cultural heritage into the contemporary context, precisely through the sustainable conservation, presentation and promotion of its values.

1.1.3. Cultural Heritage and the Question of Its Sustainable Conservation

The development of the concepts of cultural tourism, cultural landscape and cultural routes at the beginning of the 20th century represents a consequence of the search for an integral and sustainable model of protection, presentation and promotion of cultural heritage in the contemporary context. The leading idea of these concepts is the perception of cultural heritage in a broader spatial, natural, cultural–historical and social context and the preservation of all aspects that participate in forming cultural heritage and its environment.

Within the framework of the *International Cultural Tourism Charter Managing Tourism at Places of Heritage Significance*, verified in 1999, a special focus is directed at the potential of using tourism in areas with heritage values, emphasising the importance of interactions between visitors and the host community [22]. On the other hand, the Charter indicates that poorly managed tourism can threaten cultural heritage, host communities’ lifestyles and the visitor’s experience of the place. Therefore, the Charter emphasises the application

of cultural tourism, in which the focus is on learning about other cultures, customs, local population's lifestyle and the values of the places visited, based on which it is possible to improve the quality of life of the local community and the economic status of the place.

The need for the sustainable conservation of cultural heritage and its environment was also confirmed through the verification of the *Landscape Convention* in 2000, within which cultural heritage officially began to be interpreted within the framework of a broader natural context and human activity [23]. The term landscape is seen as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Article 1, Paragraph a) [23], and cultural heritage is an integral part of it. Sustainable landscape management includes the integral preservation of all constituents of the cultural landscape, through their appropriate and unified protection, presentation and promotion aligned with social, economic and environmental processes.

In the context of cultural heritage's sustainable conservation, the concept of cultural routes, within which the principles of cultural tourism and cultural landscape are united, stood out. By verifying *The ICOMOS Charter on Cultural Routes* in 2008 [24], the phenomenon of the cultural route is seen as a spatial-program link between different cultural-historical, natural and social aspects that make up the tangible and intangible values of a place and within which cultural heritage constitutes its essential integral part. Particularly noteworthy are "context, content, cross-cultural significance as a whole, dynamic character, and setting" [24] (pp. 3–4) as key elements of the cultural route of which adequate protection, presentation and promotion enable the establishment of sustainable development of all constitutive elements of the cultural route, including cultural heritage. The previously analysed topics in the field of cultural heritage preservation, with a focus on its values, authenticity and sustainability, are summarised in Figure 1.



Figure 1. The main themes of documents related to cultural heritage sustainable conservation (provided by authors: Nikolić M., Ščekić J., Drobnjak B. and Takač E.).

1.2. Industrial Heritage and the Analysis of Relevant Documents

The previously presented documents in the field of cultural heritage preservation point to the development of ideas about cultural heritage in the 20th century, initiated by the Athens Charter in 1931. Although cultural heritage research at the global level covers a period of almost a century, certain typologies of cultural heritage, such as industrial heritage, have been unjustifiably neglected for a long time. The actualisation of the issue of the position of industrial heritage as a typology of cultural heritage that should enjoy a certain degree of protection, presentation and promotion begins with the Council of Europe's *Recommendation No. R (87) 24* from 1987 and *Recommendation No. R (90) 20* from 1990 [25,26]. While the first Recommendation emphasises the need to regenerate industrial cities as former carriers of economic development, the Recommendation from 1990 officially recognises the importance of industrial heritage as an integral part of Europe's cultural heritage. Further development of reflection on industrial heritage was encouraged by the establishment of The International Committee for the Conservation of the

Industrial Heritage (TICCIH) in 1999. Formed with the aim “of promoting and advancing the education and international cooperation of people in safeguarding, conserving, investigating, documenting and researching all aspects of the industrial heritage in the world” [27] (p. 1), TICCIH is the leading organisation in industrial heritage research and the main initiator for improving its condition in a contemporary context. To date, the most significant document in the field of industrial heritage preservation, verified by TICCIH in 2003, is *The Nizhny Tagil Charter for the Industrial Heritage* [28]. The Charter recognises the influence of the Industrial Revolution, which changed the way of life globally in the 18th and 19th centuries. Former industrial complexes, methods of production, machines, but also the natural environment and cities within which production facilities were located are beginning to be seen as cultural–historical and technical–technological testimonies of a significant period of time for all of humanity. The Charter provided the first definition of industrial heritage, which consists “of buildings and machinery, workshops, mills and factories, mines and sites for processing and refining, warehouses and stores, places where energy is generated, transmitted and used, transport and all its infrastructure, as well as places used for social activities related to industry such as housing, religious worship or education” [28] (p. 2). The particular importance of *The Nizhny Tagil Charter* refers to defining a set of guidelines for approaching industrial heritage in practice, its analysis, protection, presentation, promotion, adequate regeneration and integration into the contemporary context. These guidelines were improved through the document *Joint ICOMOS—TICCIH Principles for the Conservation of Industrial Heritage Sites, Structures, Areas and Landscapes*, verified in 2011. The so-called *Dublin Principles* include four key categories of principles through which industrial heritage research is approached in practice, and they refer to the following: documenting and understanding industrial heritage (Paragraphs 3–5); protecting and conserving industrial heritage in an effective way (Paragraphs 6–9); conserving and maintaining industrial heritage (Paragraphs 10–12); and presenting and communicating industrial heritage dimensions and values to raise public and corporate awareness and support training and research (Paragraphs 13–14) [29]. *The Dublin Principles*, together with *The Nizhny Tagil Charter*, represent today’s current and indispensable documents in the research of industrial heritage and the possibility of its integration into the contemporary context.

However, these documents tend to overlook the protection of movable industrial heritage, including industrial machines and transport vehicles. On the other hand, important documents dealing with the preservation of movable industrial heritage are *The Turin Charter*, *The Barcelona Charter* and *The Riga Charter* [30–32], focused on preserving historic vehicles [30], ships [31] and railroad vehicles [32]. They emphasise the need to develop recommendations and principles for preserving specific movable industrial heritage typologies. Their inclusion in the process of industrial heritage preservation in practice, alongside the previously mentioned *Nizhny Tagil Charter* and *Dublin Principles*, is the prerequisite for the sustainable conservation of industrial heritage.

1.2.1. Industrial Heritage and the Question of Its Values

As with other types of cultural heritage, an important aspect of studying industrial heritage is related to the analysis of its values. Once again, the importance of *The Nizhny Tagil Charter* is confirmed, within which typologies of industrial heritage values were defined for the first time, including historical, technological, social, architectural and scientific value [28] (p. 2). These values are seen through the tangible remains of the industrial heritage (objects, their architectural and constructive elements, machines), that indicate the former way of production, technical–technological achievements, spatial–program organisation and purpose, as well as through the intangible remains of the industrial heritage that are related to its cultural–historical and social significance. Given that they include a set of tangible and intangible values that reflect not only the characteristics of the material remains that we call industrial heritage but also their relationship with the space

and people over time, the understanding of industrial heritage values is directly taken from the preservation of cultural heritage and its values [8–14].

1.2.2. Industrial Heritage and the Question of Its Authenticity

In addition to the previously highlighted values of industrial heritage, an important aspect of its preservation relates to its authenticity and integrity. The understanding of the concepts of authenticity and integrity of industrial heritage is directly taken from previously verified documents in cultural heritage preservation [4,15–17,21]. Within *The Nizhny Tagil Charter*, the question of preserving the authenticity and integrity of the industrial heritage is considered in the context of the introduction of new interventions and the reuse of the industrial heritage in relation to contemporary needs and the context in which it is located [28] (p. 4). In particular, the importance of adequate conservation and presentation of authentic machines and other components of industrial complexes that indicate the former way of their use and their purpose [28] (p. 5) is highlighted. On the other hand, within *The Dublin Principles*, it is emphasised that “legal recognition, adequate conservation and management” ensure the preservation of the authenticity and integrity of the industrial heritage [29] (Paragraph 7). However, to determine what is adequate in preserving industrial heritage, its authenticity and integrity, it is first necessary to understand its values. It is precisely the analysis of recognised typologies of the value of industrial heritage that constitutes a prerequisite for preserving the authenticity and integrity of industrial heritage in the process of its restoration and integration into the contemporary context.

1.2.3. Industrial Heritage and the Question of Its Sustainable Conservation

In addition to the recognised need for the preservation of industrial heritage as an important typology of cultural heritage, with a particular emphasis on the protection of value, authenticity and integrity, the question of its sustainable conservation is brought up to date. The issue of *sustainability* in preserving industrial heritage is encouraged by numerous documents verified by the United Nations, which, at the global level, consider the issue of climate change and the establishment of sustainable models to improve the quality of life. Among them, the most comprehensive and globally influential is *The 2030 Agenda for Sustainable Development*, adopted in 2015 [33]. *The 2030 Agenda* contains the principles of previously verified documents, among which *Agenda 21* from 1992, *The Rio Declaration on Environment and Development* from 1992 and *The Resolution from the World Summit on Sustainable Development* from 2002 are of particular importance [34–36]. The importance of *The 2030 Agenda* is reflected in the recognition of “people, planet, prosperity, peace, partnership” [33] (p. 2) as crucial to improving the quality of life at a global level. The 17 Sustainable Development Goals were defined, through which the most important aspects for improving the quality of life and establishing sustainable development were highlighted and included within the three dimensions of sustainability: economic, ecological and social. In the context of preserving cultural heritage as part of the built environment, goals 11 and 12, which promote *sustainable cities and communities*, as well as *responsible consumption and production*, are particularly noteworthy. However, as we approach the year 2030, it can be seen that the goals set within the Agenda have not been fully achieved. As a consequence of that, but also of the changed way of life after the COVID-19 pandemic, another initiative is being launched in 2020: *The World in 2050*, focusing on innovative solutions for establishing sustainability [37]. In addition to the Agenda, another document, the *Davos Declaration*, indicates the importance of establishing sustainable development. However, the specificity of the *Davos Declaration*, verified in 2018, is reflected in the emphasis on “the central role of culture in the built environment” [38] (p. 10) and the improvement of the quality of the built environment, precisely, through the use of culture. Consequently, the verification of the *Davos Declaration* officially recognised the possibilities of using heritage as a phenomenon that contains elements of culture and the built environment, with the aim of improving the quality of the built environment. Like the previously defined 17 Sustainable Development Goals, eight criteria for a high-quality Baukultur were defined

based on the *Davos Declaration*: governance, functionality, environment, economy, diversity, context, sense of place and beauty [39]. Bearing in mind the inclusion of the cultural and industrial heritage values, the definition of authenticity and integrity, as well as the goals of the concepts of cultural tourism, landscapes and routes that were presented in the previous part of this paper, the eight criteria of Baukultur can easily be connected with the already-defined principles in the field of cultural and industrial heritage preservation.

On the other hand, the official recognition of the potential of using industrial heritage as an economic, ecological and social resource for establishing sustainable development and improving the quality of the environment began in 2001, with the adoption of *The Declaration of Duisburg* [40]. In addition to indicating the importance of industrial heritage as a part of collective identity, the *Declaration* indicates that “the sustainable development of our industrial heritage helps to secure the economic and social regeneration of municipalities” [40] (p. 1). A special contribution of the *Declaration* refers to the promotion of the project *The European Route of Industrial Heritage (ERIH)* [41], which aims to apply the principles of the concept of cultural routes in the domain of European industrial heritage. The *ERIH* aims to network, at the regional and international levels, the most significant examples of industrial heritage, the so-called *Anchor Points*, all through the formation of the main cultural route as a starting point for the subsequent development of other industrial routes. Moreover, the *ERIH* recognises and applies the principles of cultural tourism as “an effective mechanism for economic regeneration, embracing social, cultural and intellectual benefits” [41] (p. 3). The applicability of the concepts of cultural routes in the sustainable conservation of industrial heritage was also recognised in the Asian context by verifying the *Taipei Declaration for Asian Industrial Heritage* in 2012 [42]. Within this document, the importance of “both national and trans-national industrial heritage” was recognised, with a particular focus on the importance of “the future cooperation between Asian countries to promote the conservation of them” by establishing “an Asian network for industrial heritage” [42] (Article XI). The later-verified *Resolution 1924* [43] from 2013, in addition to confirming the importance of establishing industrial routes, promotes the importance of implementing the cultural landscape principle and the value of industrial heritage for society.

Thanks to *Resolution 1924*, the question of the relationship between cultural, i.e., industrial heritage, people and the ambiguous (spatial, natural, cultural–historical and social context in which it is located) was actualised. In this regard, there is a need for an integral and sustainable conservation of industrial heritage through the process of its reuse in the contemporary context and way of life, while at the same time respecting all its values, authenticity and integrity. The so-called *reuse concept* is also recognised in the previously presented documents from the field of industrial heritage preservation [28,29,42,43]. However, it gets a marked expansion within its application, in the processes of industrial heritage preservation *in practice*. The term “reuse” itself means “to use again, especially after salvaging or special treatment or processing” [44], which indicates a kind of transformation process that something undergoes for its own survival. In the context of industrial heritage reuse, the transformation must be controlled and clearly predetermined while respecting all the previously presented cultural and industrial heritage preservation principles. In order to achieve this, another one is highlighted: the concept of adaptive reuse, which encourages finding a suitable new purpose that will simultaneously respond to the needs of contemporary society and the context, but also be harmonised with the values of the industrial heritage. This understanding of the concept of adaptive reuse in the context of heritage preservation is also promoted in the work of Bottero et al. [45], in which the authors point out that “the expected outcome is not only the protection of the building, but the preservation of its historical and heritage significance” [45] (p. 2). The concept of adaptive reuse has become the focus of numerous studies aimed at sustainable solutions for heritage preservation, which include both review papers, as well as case studies of the application of this concept in practice [45–51]. Through research, various methods for applying this concept in practice, aspects that should be included, and the level of success

of the concept to simultaneously comply with all the principles of heritage preservation, realise its sustainable potential and contribute to its integration into the contemporary context are emphasised. The concept of adaptive use is indirectly supported by the *Dublin Principles*, which indicate that “appropriate original or alternative and adaptive use is the most frequent way and often the most sustainable way of ensuring the conservation of industrial heritage sites or structures” [29] (p. 5). Also, it emphasises the need for the engagement of experts in the industrial heritage’s protection to preserve its significance through new uses. Moreover, successfully applying the adaptive reuse concept in practice requires the participation of the local community and all interested parties throughout the entire process. Because of that, research into applying the adaptive reuse concept in practice focuses on promoting the importance of stakeholder participation. Relevant experts conduct surveys and interviews with stakeholders, i.e., the local community, government and other interested parties, to understand contemporary society’s needs, perception and understanding of industrial heritage [51–53]. Through contemporary society’s direct inclusion into the adaptive reuse process, it is possible to recognise their needs and respond to them. It is possible by introducing new, compatible uses in spaces with heritage values while respecting all the principles of preserving industrial heritage and the concept of sustainability. In this way, former industrial complexes and monuments of technical culture can be actively used and integrated into a contemporary context, following the needs of a contemporary society. The previously analysed topics in the field of preservation of industrial heritage, with a focus on its values, authenticity and sustainability, are summarised in Figure 2.



Figure 2. The main themes in documents related to industrial heritage sustainable conservation (provided by authors: Nikolić M., Ščekić J., Drobňak B. and Takač E.).

1.3. The Main Themes in Industrial Heritage Sustainable Conservation

Based on the analysis of relevant documents in the field of preservation of cultural and industrial heritage, which was carried out in the previous part of this paper, it is observed that the issues of preservation of value and authenticity represent an unavoidable aspect in the research of any typology of heritage, including industrial. On the other hand, stimulated by the concept of sustainability, the scope of heritage preservation goes from the domain of protection of material remains, through the protection, presentation and promotion of all its values and authenticity, until finding a model for its integral and sustainable preservation. In this context, the potential of industrial heritage as a suitable starting point for examining its sustainable conservation in practice was particularly highlighted. It is, first of all, a consequence of the characteristics of former industrial complexes, which often included large spatial capacities that enabled the introduction of different contents and purposes through the process of industrial heritage’s adaptive reuse. Based on the above-mentioned, it can be observed that in the process of sustainable conservation of industrial heritage, the following themes are distinguished:

- Industrial heritage values;

- Industrial heritage authenticity;
- Industrial heritage sustainability.

They are processed optimally, respecting all relevant documents and principles precisely through the concept of industrial heritage's adaptive reuse (Figure 3). This concept, in addition to respecting industrial heritage values and authenticity, is characterised by the success of transforming industrial heritage from the status of an isolated monument of technical culture to the status of living heritage that forms an integral part of contemporary life and responds to the needs of contemporary man, making the industrial heritage sustainable.

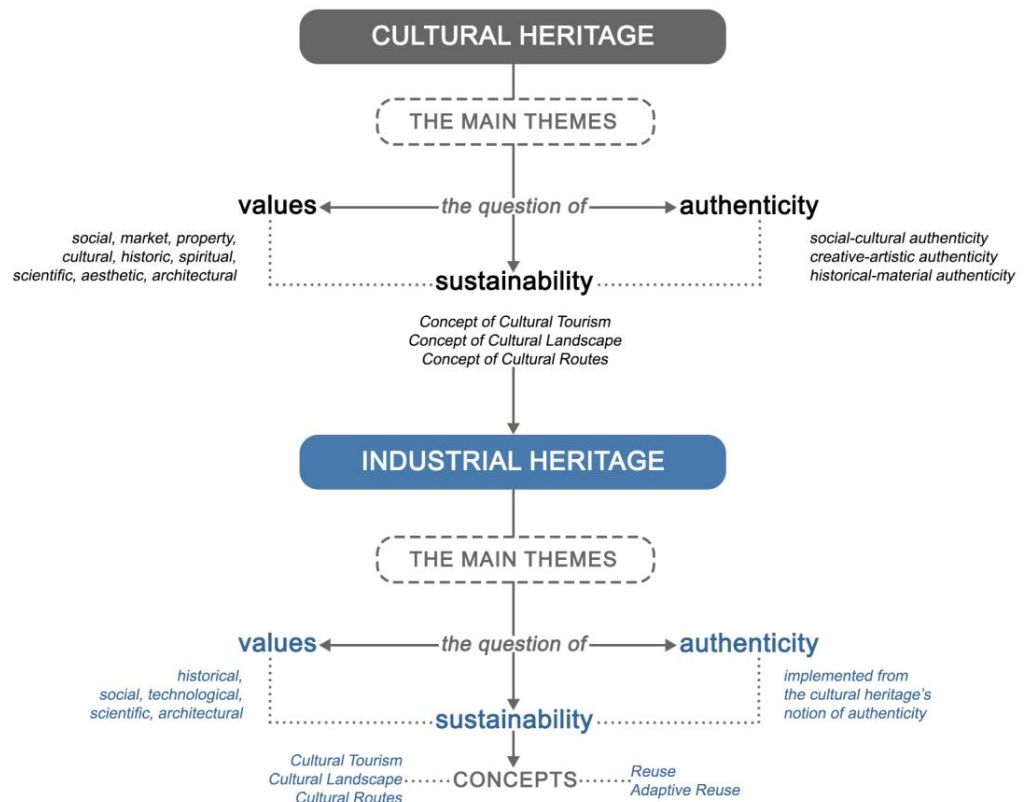


Figure 3. Translating the main themes from cultural to industrial heritage (provided by authors: Nikolić M., Šćekić J., Drobnjak B. and Takač E.).

This research paper considers the issue of sustainable conservation of industrial heritage through the potential of applying the concept of its adaptive reuse. Through case studies of the industrial heritage of the city of Belgrade, which currently does not enjoy the status of adequate protection, presentation and promotion and is largely devastated, the possibilities of their integral and sustainable conservation through the introduction of new uses while respecting the principle of preserving the value and authenticity of the industrial heritage, are considered. This research paper focuses on the possibility of translating theoretically promoted principles and concepts of sustainable conservation of industrial heritage into their practical application, using the case studies of Belgrade's industrial heritage as a research site. An important aspect of the research relates to the definition of methodology and criteria for the valorisation of the results presented in Section 2., which directly resulted from the analysed principles and concepts of sustainable conservation of industrial heritage. The research was conducted through the development of students' conceptual solutions for the revitalisation of selected case studies of the industrial heritage of the city of Belgrade, which became a representation of its alternative future, analysed in detail in Section 3., later valorised through Section 4. of this paper. Also, the presentation of the history and development of the industrial heritage of the city of

Belgrade as an important and unjustifiably neglected typology of cultural heritage in the Republic of Serbia, which follows in the continuation of this paper, point to the potential of its integration within the framework of industrial heritage routes, at the local and regional, and European levels.

2. Materials and Methods

2.1. *Industrial Heritage in Belgrade*

2.1.1. Historical Overview of Industrial Heritage in Belgrade

The industry development in the territory of the city of Belgrade can be traced back to the 19th century when the city began to take on the characteristics of a modern European capital. The first steps towards the modernisation and development of Belgrade as the European capital and the most important commercial, import and export centre of the Principality of Serbia took place in the middle of the 19th century, with the appearance of manufacturing workshops, warehouses and river traffic [54]. The specific geographical position at the confluence of two European rivers, the Sava and the Danube, enabled the development of river traffic to ensure connections with neighbours, which also conditioned the development of coastal zones. The banks of the Sava under the city area Kosačićev Venac developed the fastest due to the direct connection with Europe via Zemun (the territory of the Austro-Hungarian Monarchy at the time). The beginning of the development of the Sava coast represented the core of the traffic and economic zone of the capital. Therefore, the Customs House (Đumrukana) was built within it. However, the most significant progress in modernising Belgrade as the capital city was achieved after the Berlin Congress in 1878 and after the proclamation of the Kingdom of Serbia in 1882. Participation in the Berlin Congress achieved complete political independence, which enabled intensive economic development after gaining economic and foreign trade independence, which conditioned the possibility of concluding contracts and conventions with other countries [55]. By achieving political independence, the Kingdom of Serbia established a stronger connection with Europe, especially with the Austro-Hungarian Monarchy, which ensured the development of the first industry and economic growth. In other words, by establishing a connection with Europe, the influx of foreign capital into the Kingdom was ensured, especially contributing to the construction of the railway station and the first railway bridge over the river Sava. The railway's construction enabled the city's development and its indirect connection with Eastern and Western Europe. With the construction of the railway, the city experienced the most significant changes in the area of the right bank of the river Sava, where the Railway Station was built in 1884, and which today stands as proof of the technical and architectural development of Belgrade as a bustling European capital [56]. In addition to the above-mentioned, the construction of the railway necessitated the construction of warehouses and industrial plants along the riverbank, of which the operation was conditioned by the proximity of the river and the possibility of importing and exporting raw materials.

In addition to railway traffic, river traffic was also of crucial importance for the development of industry in the territory of the city of Belgrade. Although the connection with Zemun on the Sava coast initiated the economic development of Belgrade, the Kingdom of Serbia played a key role in economic development in 1890 through special privileges for navigation on the river Danube. By obtaining the privilege of navigation on the Danube, the Kingdom of Serbia strengthened its ties with its neighbours, which enabled Belgrade, as its capital, to additionally secure its role as the centre of import–export trade, banking and industry. The development of river traffic was influenced by the construction of factories from 1895 to 1911, the carriers of the development of the food, textile and wood industries on the right bank of the river Danube, which became one of the largest and most compact industrial zones in the territory of the city of Belgrade. In other words, the industry in Belgrade, from its beginnings in the 19th century until the First World War, was a major carrier of modernisation and had the most significant impact on urban development [57].

The period between the two world wars, due to the rapid industrialisation of the country, caused industry as an economic branch to become one of the key pillars of the economic progress of the young Yugoslav state, especially after the Second World War when numerous and diverse industrial productions were launched throughout the Socialist Federal Republic of Yugoslavia, according to the socialist principles of self-management [58] (Figure 4).

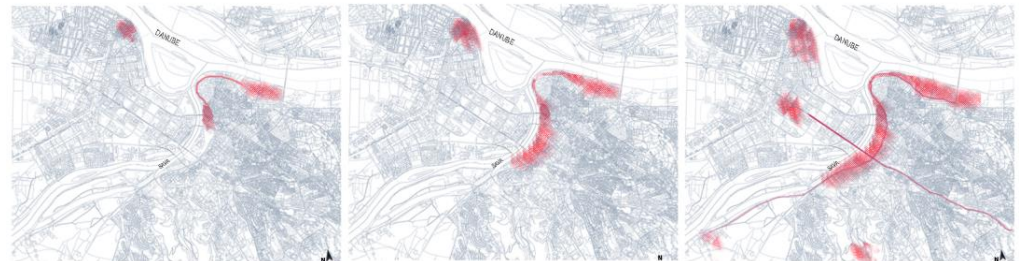


Figure 4. Development of industrial zones in Belgrade (**Left**—development from XIX to the First World War; **Middle**—development between the two World Wars; **Right**—development from Second World War until the 1970s) (provided by authors: Nikolić M., Šćekić J., Drobnjak B. and Takač E.).

According to the above-mentioned, we can discern seven industrial zones in the territory of the city of Belgrade, three of which are in the direction of the western currents (the highway route in the territory of the city (Highway E75 is part of the pan-European corridor X that connects Norway with Greece)), the city municipality of Novi Beograd, the city municipality of Zemun, two zones in the vicinity of populated areas (the city municipality of Rakovica and the settlement of Makiš) and two zones that extend along the Sava and Danube banks [59] (Figure 5).

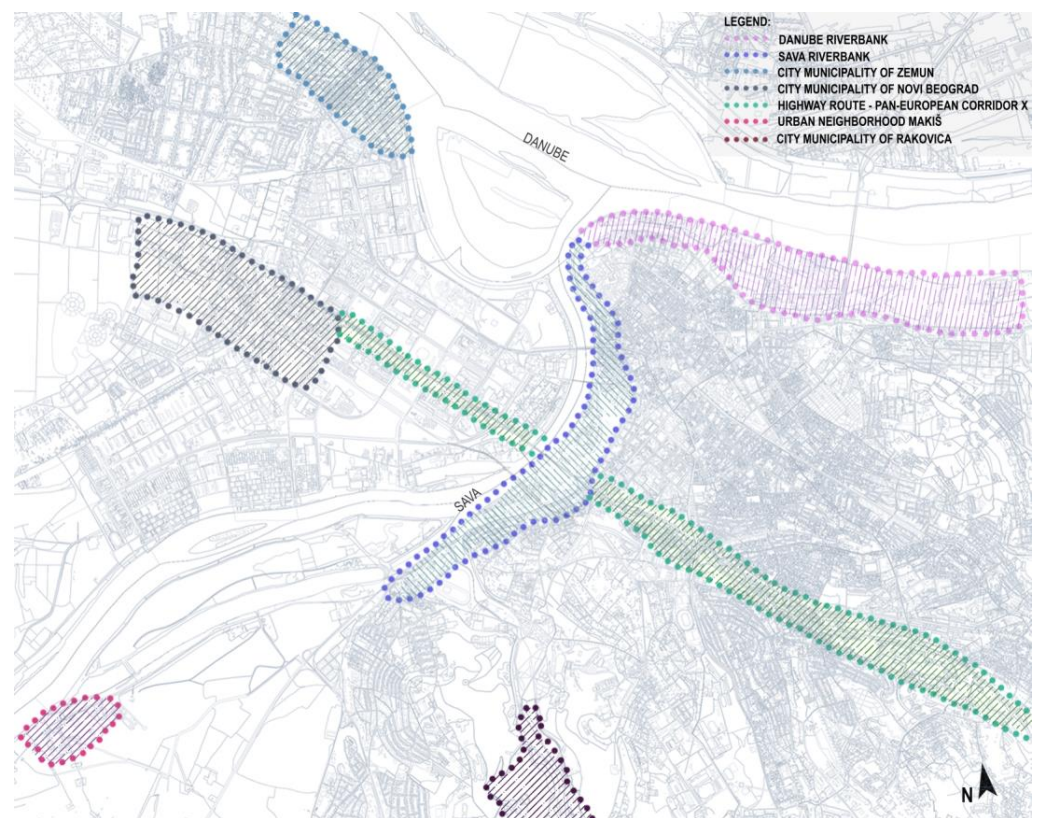


Figure 5. Industrial heritage in Belgrade—industrial development zones (provided by authors: Nikolić M., Šćekić J., Drobnjak B. and Takač E.).

The decline in the Serbian industry has been recorded since the end of the 1980s and the beginning of the 1990s of the 20th century, when the civil war in the territory of the former Yugoslavia led to the current situation in Serbia's and Belgrade's economy. Although this is not the only reason for the termination of work of various companies, it certainly greatly impacted the present-day existence of abandoned industrial complexes in the broader and narrower territory of Belgrade. Another significant reason for the existence of non-functional buildings, and even entire industrial complexes in the central city zones, lies in the fact that the edges of today's central Belgrade municipalities represent the periphery of the former Belgrade [60].

With the expansion of the city territory, these complexes became surrounded by residential districts, and their non-complementarity with the environment came to an even greater expression with the termination of work and gradual deterioration. Based on these facts, we can conclude that the development of Belgrade's industry during the 19th and 20th centuries went through turbulent political and social processes recorded in the architectural expression of industrial buildings. In other words, the industrial heritage of the city of Belgrade, in addition to its architectural and technical value, also has a great social value because it represents an important element in the realisation of its cultural identity.

2.1.2. Contemporary Development of Industrial Heritage in Belgrade

The urban development of Belgrade and modern construction in recent decades greatly impacted the preservation of the city's rich industrial heritage. The city's expansion caused the relocation of industry and economic activities to suburban settlements, as a result of which their original areas and positions were transformed into commercial activities and residential structures. The transformation of the Sava coast illustrates a characteristic example of modern construction and an inadequate attitude towards industrial zones. In recent years, Belgrade's important industrial zone has been transformed into a new modern centre with skyscrapers, towers, and mixed-use spaces for residential, business and commercial purposes. However, this transformation has come at the cost of demolishing and repurposing former industrial facilities, resulting in the loss of the city's recognisable urban landscape with its specific morphology and typology.

Nevertheless, there is a real possibility of revitalising the area of the former industrial zone through the appropriate integration of existing industrial structures and other cultural heritage. This should be done while respecting environmental sustainability, protecting cultural and industrial heritage, and ensuring compatibility of new contents with inherited values [58]. In order to mitigate the process of rapid urban development of the city and prevent the emergence of another globalist phenomenon, such as the inappropriate transformation of the Sava coast, it is necessary to redefine the relationship towards conservation issues of the specific character of these historical settings and complexes through urban and spatial planning, as well as through the protection of old industrial zones (Figure 6).

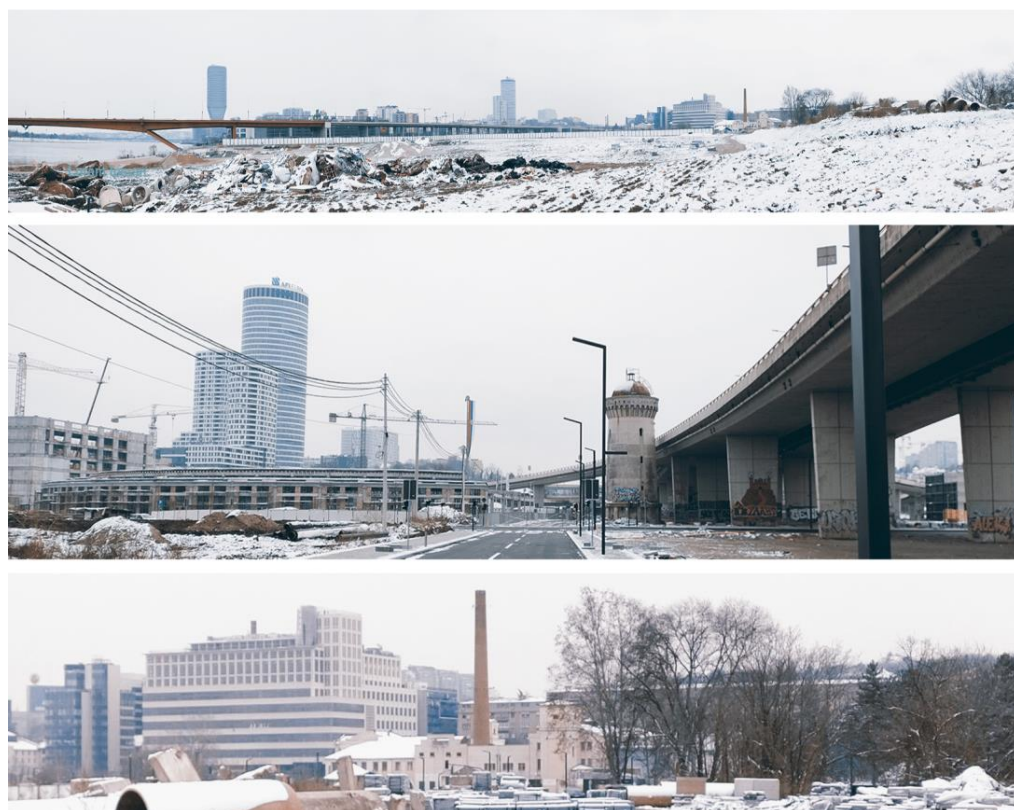


Figure 6. Contemporary development and its relationship with industrial heritage on the Sava riverbank (provided by authors: Nikolić M., Ščekić J., Drobnjak B. and Takač E.).

2.1.3. The Current State of Industrial Heritage in Belgrade

Generally speaking, the state of monuments of technical culture, which is also an integral part of the cultural identity of every society, is not at a satisfactory level in the Republic of Serbia and the city of Belgrade because the buildings are out of function, separated from the contemporary life of the city, resulting them to gradual decay.

The reason for such a state of this type of cultural heritage is reflected in the state's lack of recognition of the importance of industrial heritage, which caused the lack of a clearly defined cultural policy. In addition to the lack of a defined cultural policy, there is a low level of intersectoral partnership and cooperation between relevant institutions, organisations, and state bodies, which could contribute to solving the problem of the survival of industrial heritage. The result of this relationship is also reflected in urban development and modern construction, which largely had an inadequate relation to the survival of the heritage of historical, technical, social, architectural and scientific values, all for the purpose of achieving economic profit. Accordingly, the need for planning and systematic protection is conditioned not only by the general importance of this specific cultural heritage typology, but also by the fact that we are witnessing the disappearance of objects of technical culture due to modern technological development.

Regarding the protection and preservation of industrial heritage, 56 objects of technical culture have been recognised on the territory of Belgrade [61]. By observing the current policy and practice in the field of cultural heritage protection of the city's territory, legal protection has been obtained by a relatively small number of objects, or monuments of technical culture, i.e., four objects enjoy the status of cultural monuments of great importance. In comparison, 16 objects are recognised as cultural monuments (Figure 7).

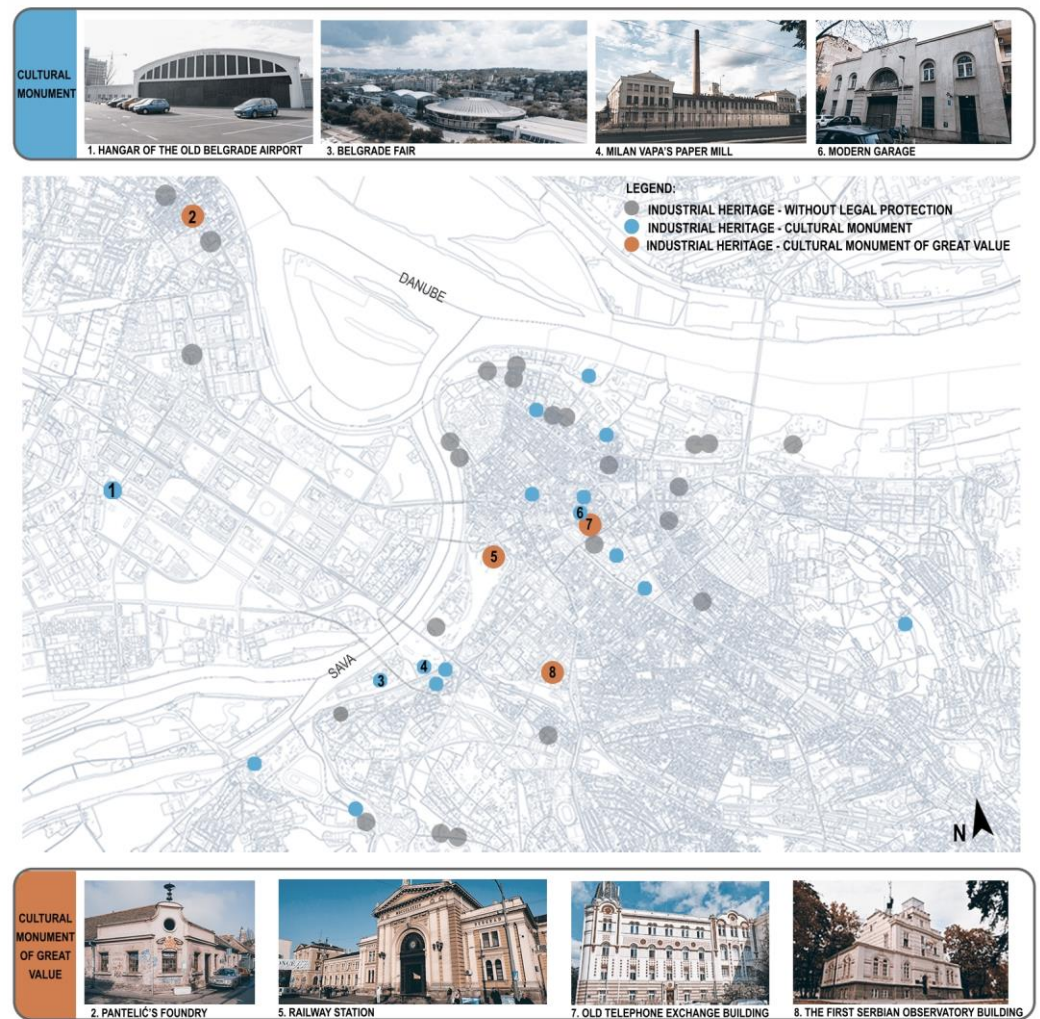


Figure 7. Industrial heritage in Belgrade—spatial disposition (provided by authors: Nikolić M., Šćekić J., Drobnjak B. and Takač E.).

Monuments of industrial heritage that have acquired legal protection as monuments of culture of great importance are the building of The First Serbian Observatory, The Old Telephone Exchange building, The “Pantelić” Foundry and The Railway Station; while the following were declared cultural monuments: Sugar Factory, Paper Factory of Milan Vapa, Astronomical Observatory, Steam Mill, Building of the State Printing Office, Steam Bath of the Krsmanović Brothers, House of Crafts Radio Belgrade, Photo Studio of Milan Jovanović, Mint, Building of the Technical Faculty, Building of Seismology Institute, Modern Garage, Hall 1 of the Belgrade Fair, Hangar of the Old Airport, Thermal Power Plant “Snaga i Svetlost” and the Art Foundry “Plastika” [61].

According to the above-mentioned, analysing the Catalog of Immovable Cultural Properties of the City of Belgrade as a relevant source of information, it can be concluded that within the 434 monuments that have been declared as cultural properties and which are under the jurisdiction of the Institute for the Protection of Cultural Monuments of the City of Belgrade, only 20 monuments represent objects of industrial and technical culture, which represents a share of 4.60% [62]. It can be said that the preservation of the industrial heritage created at the end of the 19th and during the 20th century in Belgrade is often marginalised, even though it represents a specific category of cultural heritage that possesses the values and characteristics of monuments (Figure 8).



Figure 8. Industrial heritage in Belgrade—diagram of the representation of industrial heritage in the Legal System of Heritage Protection (provided by authors: Nikolić M., Ščekić J., Drobnjak B. and Takač E.).

A significant shift in the approach to the protection, revitalisation and presentation of industrial heritage in the Republic of Serbia took place in 2007 after the signing of the *Protocol on partnership cooperation in the field of integral protection* [63]. The document was formed concerning the fact that, although a high number of movable scientific and technical assets are located within immovable monuments of technical culture, they are not viewed as a unique entity of technical culture in the entire territory of Serbia. Also, the lack of human resources within the Institute responsible for the preservation of immovable cultural assets affects the impossibility of forming a standardised method for the preservation of cultural monuments based on the model of relevant international conventions, charters and recommendations, as indicated by the author Kadrijević [64].

By signing this document between the Ministry of Culture of the Republic of Serbia, the Museum of Science and Technology, the Republic Institute for the Protection of Cultural Monuments, the Provincial Institute for the Protection of Cultural Monuments and twelve other institutes for the protection of cultural monuments, the first step was taken, which represents the legal framework for all further activities and which projects protective measures that should be taken in the future. Also, in relation to the laws in force in our country, movable and immovable cultural property is placed under integral protection by a unique legal act that guarantees protection to immovable property and movable property contained in it. Thus, the initial conditions were created which, through further work on designing and planning works for the integral protection, promotion and popularisation of scientific and technical heritage, would enable Serbia, with its technical and industrial heritage, to join the world and European organisations such as the ERIH and TICCIH through the regional industrial heritage route [65].

The first steps towards registering Serbia's industrial heritage in the framework of the European industrial map were achieved through the connection of the Coal Mining Museum in Senjski Rudnik to the ERIH network in 2013 [66,67]. However, the Coal Mining Museum is still the only example of integrating Serbia's industrial heritage outside the local and national context. At the same time, numerous important monuments of technical culture in Serbia and Belgrade still do not enjoy appropriate preservation treatment and, above all, contemporary presentation.

On the other hand, by implementing the *Protocol on partnership cooperation* in matters of integral protection, an effort was made to find an adequate approach to the preservation of industrial heritage and its contemporary presentation on the territory of the city of Belgrade, which is primarily reflected in the modernisation of legal systems and the aspiration towards the integral protection of all the values of industrial heritage. Since the industrial heritage is an important factor in the historical and urban identity of a city, valuing it in the right way and revitalising it with contents that serve to meet the needs of the local population, the objects would not only receive adequate care and protection, but would also significantly contribute to quality progress of the community. Therefore, in the context of the current policy and practice in the field of cultural heritage protection in

Belgrade, it is necessary to work intensively on informing citizens about the importance of industrial heritage and the responsibility we have towards its protection, as well as about the needs and possibilities for its inclusion in contemporary life [68].

In order to enable the contemporary life of industrial heritage monuments, it is necessary to design sustainable solutions that would, on the one hand, preserve the development stages, authenticity and integrity of the industrial complex and, on the other hand, ensure its reactivation and adequate integration into the modern urban environment. In order to avoid inadequate approaches to presentation and revitalisation, as well as in order to preserve the authentic technological elements and recognisable historical ambience (halls, chimneys, constructions, machinery, etc.), it is necessary to incorporate international recommendations to a greater extent into the contemporary practice of protection and revitalisation of this specific type of heritage, because they establish the basic definitions and principles of protection and revitalisation of industrial heritage in the world. Adopting the guidelines provided in international charters could lead to more adequate protection and presentation of industrial heritage at the local level—in the context of the Republic of Serbia and the city of Belgrade. This research will further deal with rare, but still worth mentioning, examples of students' conceptual solutions for transforming industrial complexes in Belgrade into places of artistic and cultural life, which were carried out as part of classes at the University of Belgrade, Faculty of Architecture. Although these sites are few, they still represent the potential for applying good practice in preserving industrial heritage at the local level, serving as focal points from which this practice could be further developed.

2.2. Examined in Theory: Education in the Field of Industrial Heritage at The University of Belgrade, Faculty of Architecture

Bearing in mind the current state of the industrial heritage in Belgrade and being aware of its potential to become an economic, ecological and social resource for establishing sustainable development and improving the quality of life in the city, researchers of the University of Belgrade, Faculty of Architecture, who deal with the issue of preserving cultural heritage in the contemporary context, came up with the idea of promoting the importance of neglected industrial heritage in Belgrade through student education. The results of this research paper represent the product of the joint work of professors, associates and students of master's and integrated academic studies of architecture, which was realised within the elective course *History and Theory 3—Visual Culture in Architectural Theory and Practice*. The students' conceptual solutions for the sustainable conservation of industrial heritage resulted from an improved methodology of teaching scientific work that started in 2019 [58]. They represent the second set of results achieved within this elective course in the period 2020–2023, including three generations of students' ideas about the possibilities of reusing industrial heritage and its integration into the contemporary context. Through the analysis of selected case studies of industrial heritage in Belgrade: The Locksmiths' Workshop and Foundry "Pantelić", Hangar of the Old Belgrade Airport and The First Modern Garage; the research aimed to introduce students to the industrial heritage in Belgrade, acquire basic knowledge about the importance and principles of preserving cultural and industrial heritage with a particular emphasis on preserving their values and authenticity. One of the key aspects was to encourage students' creative thinking about the possibilities of sustainable conservation of industrial heritage and its reuse aligned with the contemporary needs. A special contribution of the conducted research refers to the definition of the methodology for the analysis of case studies and the development of students' conceptual solutions, as well as the definition of a set of criteria for their subsequent valorisation.

2.2.1. Defining the Methodology

The research methodology consists of 3 phases (Figure 9), including a combination of theoretical and in situ research, creative process and valorisation.

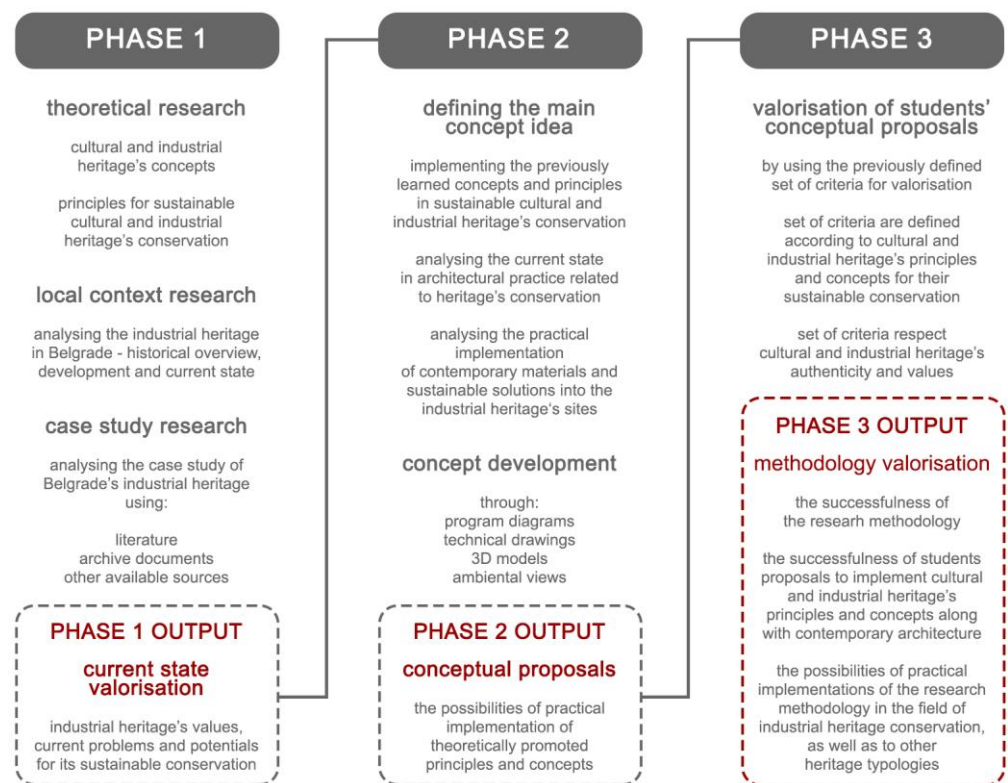


Figure 9. The methodology phases (provided by authors: Nikolić M., Šćekić J., Drobnjak B. and Takač E.).

Phase 1

As part of phase 1 of the research, students were able to familiarise themselves with the basic principles of preserving cultural and industrial heritage through theoretical lectures. A particular focus is directed to studying their values and authenticity, along with the display of relevant international documents in cultural and industrial heritage preservation. Also, based on the available literature, archival material and other sources, the students were able to analyse case studies of industrial heritage in Belgrade, within which they studied the socio-political context in which the object was built, its historical development and purpose over time, and then its values as industrial heritage, its cultural and historical significance and, finally, the current state of the analysed object of technical culture and the measures implemented so far for its protection.

Phase 2

The following research phase included defining and elaborating the students' urban-architectural concepts and conceptual solutions for the sustainable preservation of the analysed industrial heritage case study. Students' conceptual solutions were created based on the previously performed valorisation of the current state of the object of technical culture, recognition of its values and aspects of authenticity, and consideration of the broader spatial, natural, cultural–historical and social context in which it is located, all in order to define the appropriate approach to its sustainable conservation. Also, the conducted analysis of the object's context made it possible to see the missing uses in the space, which could, through the process of reuse of the industrial heritage while respecting all principles of preservation, become its new value, thus contributing to the integration of the industrial heritage into the contemporary context.

Phase 3

The last research phase refers to the valorisation of students' conceptual solutions, with a particular focus on the fulfilment of the principle of preserving values and authenticity, on the one hand; that is, on the successful integration of industrial heritage into the contemporary context and on ensuring its survival for future generations through the introduction of new, complementary purposes. The valorisation of students' conceptual solutions made it possible to see the positive aspects of the applied research methodology, as well as the potential for its improvements in further research.

2.2.2. Defining the Set of Criteria

Within the presented work methodology, Phase 3 includes valorising students' conceptual solutions, which was carried out based on a previously defined set of criteria. This set of criteria was created based on the analysed principles of cultural and industrial heritage preservation, bearing in mind the need to utilise the sustainable potential of industrial heritage and the importance of its integration into the contemporary context. The leading idea of preserving the cultural–historical, social, architectural, technological and aesthetic values of the industrial heritage through respect for the principles of authenticity and sustainable development while applying the concept of adaptive reuse was transformed into a set of criteria on the basis of which the level of success of its realisation is assessed.

Ten criteria have been defined that are directly derived from the key themes previously recognised in this paper in the process of sustainable preservation of industrial heritage: values, authenticity and sustainability (1.3 *The Main Themes in Industrial Heritage's Sustainable Conservation*). The defined criteria refer to the following:

1. Preserving the spatial organisation;
2. Preserving the structural assembly;
3. Preserving the stylistic features;
4. Preserving/presenting the previous purpose;
5. Preserving/integrating into the context;
6. Preserving the spirit of the place;
7. Defining the character of new uses;
8. Compliance of new uses with the values of the object;
9. Applied materialisation;
10. Applied principles of sustainability.

Although all criteria contain aspects of preservation of values and authenticity, as well as principles of sustainability, it is observed that all criteria examine respect for the values of industrial heritage, but also that certain criteria include the themes of authenticity and sustainability to a greater or lesser extent.

In this regard, criteria 1–3 fully support the principles of authenticity through the preservation of authentic architectural and constructive elements, stylistic characteristics of the facade and the arrangement of spatial entities within the building.

On the other hand, criterion 4, although it includes the aspect of authenticity through enhancing the achievement of the continuity of purpose (if the purpose has not been overcome), it cannot be viewed outside of its relationship with criteria 7–8, which also include the principles of sustainability expressed through the concept of adaptive reuse.

Criteria 9–10 refer to the technical–technological application of sustainable solutions in the process of restoration of the industrial heritage. However, they also contain the aspect of authenticity, which is reflected in their integration with the existing elements of the object.

For criteria 5–6, it can be said that they contain all three essential themes in the industrial heritage sustainable conservation, which are considered through both material and non-material aspects, including issues of cultural–historical and social significance of industrial heritage (Figure 10).

The result of this research paper consists of students' conceptual solutions for the sustainable conservation of selected case studies of industrial heritage in Belgrade, pre-

sented in the continuation of this paper within Section 3. Given that they represent projects with a pronounced contemporary architectural expression, critical valorisation of their incorporation into spaces with heritage values is particularly emphasised. Searching for the values and authenticity of the industrial heritage, as well as for sustainable solutions for its restoration through a defined set of criteria for the valorisation of students' conceptual solutions, ensures the making of thoughtful, responsible and argument-supported decisions about future architectural interventions on monuments of technical culture in practice. Moreover, it is guaranteed that the tangible and intangible values of the industrial heritage in the process of its sustainable conservation are recognised through the concept of adaptive reuse, and by using contemporary architecture as a tool for realising that process, they will not be endangered.

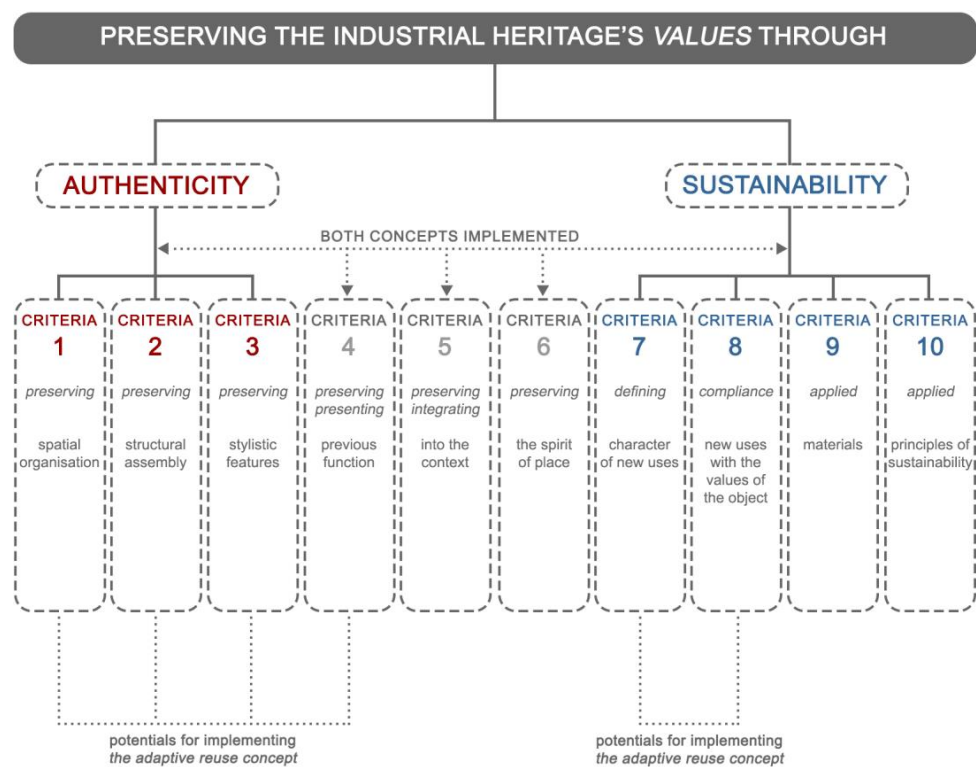


Figure 10. The set of criteria for valorisation (provided by authors: Nikolić M., Šćekić J., Drobnjak B. and Takač E.).

3. Results

3.1. The Locksmiths' Workshop and Foundry "Pantelić"

The "Pantelić" foundry is located in the inner-city core of the Belgrade municipality of Zemun. Numerous objects in this part of the city have the status of cultural property and cultural property of great importance.

The foundry was founded in 1854, and according to the plans of Zemun builder Josif Marks, the old foundry building was reconstructed in 1926 in the spirit of historicism [69]. Over time, the small workshop grew into a foundry of tower clocks for churches, schools and important city palaces. Along with the manufacture of watches, the workshop began to cast bells for schools, courtrooms and authorities, and soon began the production of large church bells [69]. The foundry covered a wide range of products, from the production of water well pumps, dog tags, signs with the names of streets, companies and professions to benches for church gates. This led to the situation in which the former small locksmith's workshop grew into a craft centre for the municipality of Zemun and its surroundings [69]. The foundry had an irregular plan, with appropriate disposition that followed craft procedures and technological processes [69]. Its space consists of a forge, a locksmith's workshop,

an old and a new foundry with casting furnaces, a warehouse and an office. The workshop complex has been preserved to this day. It includes a large ground-floor building with an asymmetric plan, which houses all the equipment and inventory of the forge, locksmith workshops, premises of the old and new foundry, warehouse and offices. The facades are simple stylistic finishes, composed in the spirit of historicism with a rhythmic row of windows highlighted by reduced geometrical decoration of the window frames and a cut corner emphasized by richer plastic with neo-baroque touches [69]. The craft production process has survived for decades and was preserved in its original form. In this way, a number of generations of craftsmen were trained. The “Pantelić” foundry represents a rarely preserved craft workshop with a unique production program and has specific architectural, urban and artistic values [69].

However, although it has enjoyed the status of a cultural monument of great importance since 1979 [70], the building has been devastated (Figure 11), which influenced our decision to make it one of the testing grounds for the possibility of sustainable conservation of industrial heritage.



Figure 11. The Locksmiths’ Workshop and Foundry Pantelić (Left—previous state, source: The Cultural Heritage Protection Institute of the City of Belgrade, link: <https://beogradskonasledje.rs/wp-content/uploads/2022/08/00-glavna-61-1024x604.jpg>, (accessed on 15 January 2024)) (Right—current state, provided by authors: Nikolić M., Šćekić J., Drobnjak B. and Takač E.).

Review of Students’ Proposal for the Revitalisation and Presentation of the Locksmiths’ Workshop and Foundry “Pantelić”

The primary idea of the students’ project is to preserve the historically valuable features of the building. In this sense, the object is preserved in its original form. The revitalisation project preserved and conserved the existing constructive schemes, spatial organisation, partition and load-bearing walls. The project proposes restoring the original appearance of the facade, while the expansion was not implemented due to the high construction density in this part of Zemun. However, the project is planned to expand the building in the form of a raised floor with the application of contrasting and contemporary forms of materialisation, aiming to create a clear visual distinction between the new and the old.

The ground floor of the building contains a central exhibition space where the preserved bells and busts produced in the foundry over the years are exhibited and presented. Moreover, the planned project implies the existence of commercial contents, a reading room, a media library, a sanitary block, a bookstore and a souvenir shop that contains replicas of exhibits that were once produced. What is significant is that the planned spatial arrangement creates a connection with the green outdoor spaces.

Contrary to the organisation of the ground floor, the first floor is designed as an open plan (Figure 12), while the new facade contains rhythmically arranged openings. The space on the first floor is organised in such a way as to give visitors a sense of flexibility through larger spatial environments and more intense lighting. The main rooms on the

first floor serve as a multifunctional hall (for exhibitions, events and cultural events) and a commercial area. If necessary, these rooms are designed to be combined into one spatial unit through mobile screens that temporarily separate them. In other words, these spatial areas are planned as multifunctional, the purpose of which is aimed at guest exhibitions, presentations of various commercial contents and the holding of various cultural events held in the territory of the municipality of Zemun. The central motif of the first-floor part of the building is a spacious terrace, a lookout point, with a view of the Danube River.

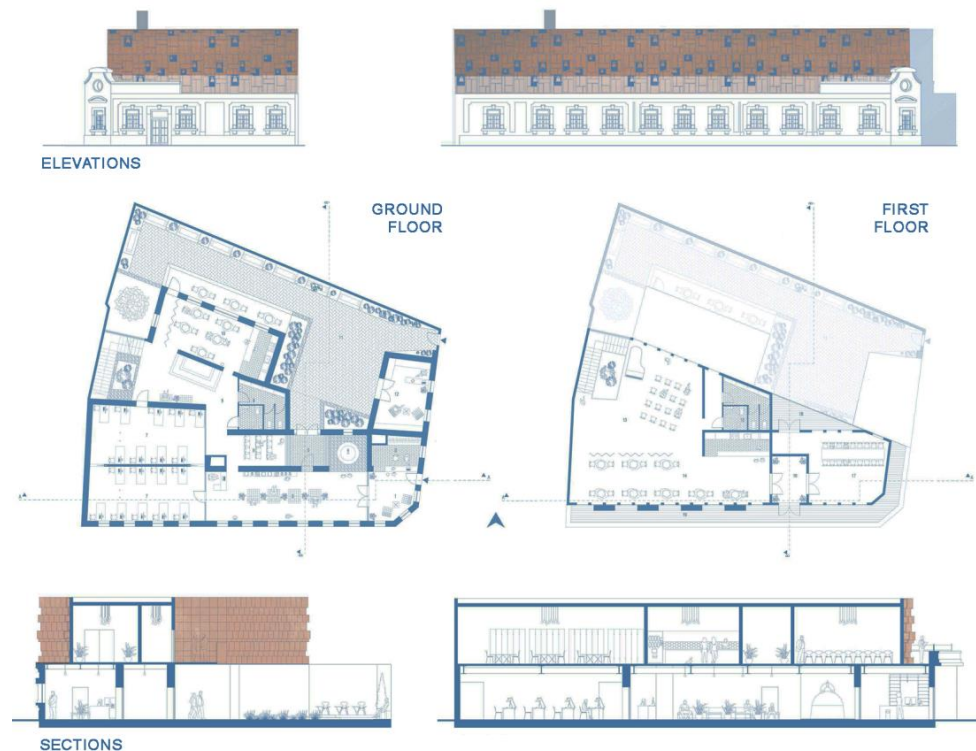


Figure 12. The students' proposal—technical drawings (drawn by authors: students Petrović D., Petrović R. and Radovanović N., 2020).

It is planned for the existing facade of the “Pantelić” foundry to be thoroughly preserved and restored based on drawings and photographs of its original appearance. The windows are planned to be replaced with aluminium–wooden ones so as not to deviate from the colour and materialisation of the existing elements of carpentry. A particular room on the first floor is a conference room intended for rent to various commercial partners to organise workshops and project presentations. It also has the possibility to function as an active workspace.

The conceptual solution for revitalising the “Pantelić” foundry facility also includes its upgrade. In this regard, the project envisages a corten facade designed to extend above the ground floor of the building. It is 2 m indented in relation to the existing facade to emphasise the relationship between the new and old structure of the building. The upgraded facade of the foundry is designed to be interlaced with bells that will be placed between Corten steel shear plates (Figure 13). Perforated sheet metal is planned to be located behind the bell, which will provide an active and attractive daylighting to the interior of the building.

The project envisages the courtyard facade of the “Pantelić” foundry to be completely renovated with white colour in order to enable the projection of old photos of the foundry and various copper engravings depicting how the building looked in the past. In this regard, the facade plane can also project presentations and films. In this manner, the courtyard area of the foundry would become active in the spring and summer months with the possibility of activating outdoor cinema projections.

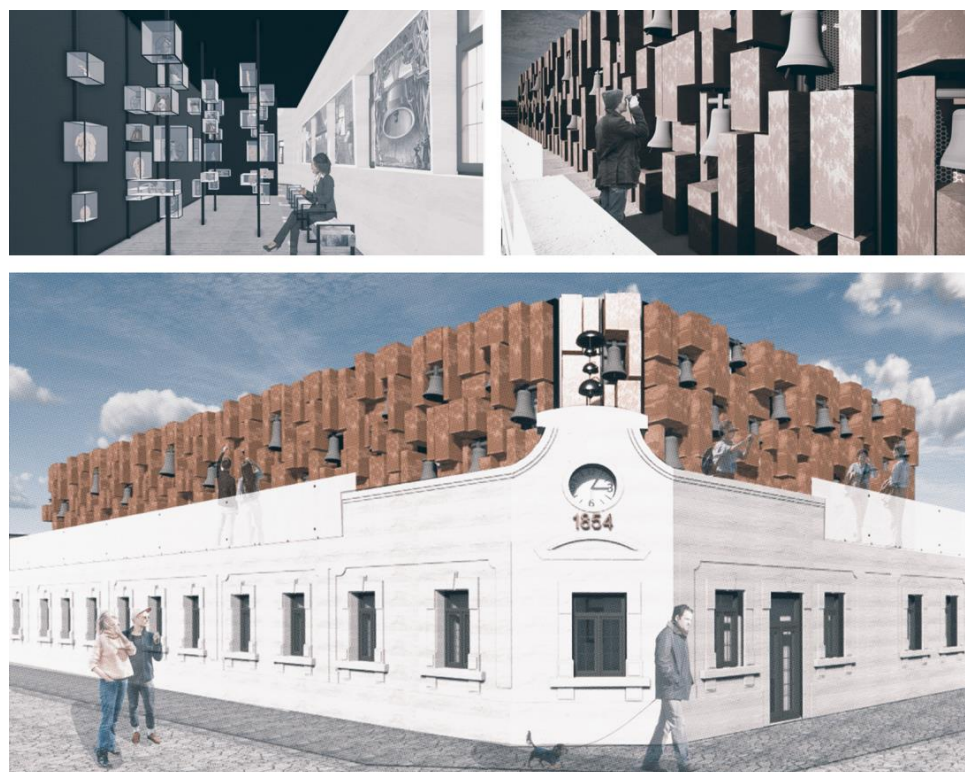


Figure 13. The students' proposal—Ambiental views (drawn by authors: students Petrović D., Petrović R. and Radovanović N., 2020).

3.2. Hangar of the Old Belgrade Airport

The hangar building of the Old Airport in New Belgrade was created during the period of pronounced social and political reorganisation of the Kingdom of Serbs, Croats and Slovenes at the time, between the two world wars. As a result of the gradual expansion of international lines within the European continent, there was an open space for the Kingdom of Serbs, Croats and Slovenes to join the newly created air transport system, and the Old Airport was precisely an attempt at that integration. In this regard, as one of the critical events in constructing a new social, political and national identity of the post-war Yugoslav state, a need for developing the domestic air force, both domestically and internationally, arose. Such aspirations towards forming a unique modern airport complex have existed before. However, this possibility only opened with the liberation of the areas north of the Sava and Danube and their annexation to the Yugoslav state immediately after the First World War [71]. On the other hand, due to the lack of raw materials and complementary industries—automotive and railway at the time—which would support the development of air traffic in the country, the more intensive development of aviation began only with the involvement of a company from Western Europe and the capital support of individuals from the country and abroad [71].

In such a context, the Old Airport hangar facility was created. It was designed between 1926 and 1931 by Milutin Milanković [72], a world-renowned scientist who made an outstanding contribution to the national and international cultural heritage with his scientific and engineering work. The hangar has a rectangular base with dimensions of 31.10 m × 31.88 m [71]. The central part is intended for accommodation, assembly and repair of aircraft. It is vaulted with an arched roof structure, which contributes to liberating the space from supporting elements, thus creating the possibility of accommodating aeroplanes and other aircraft [71]. Above the central space of the hangar, a gallery was formed, which can be reached by an internal staircase. In contrast, in the annexes, the space is divided into several rooms of different dimensions intended for workshops [71]. The main (eastern) facade contains an entrance area that can be accessed by aircraft of

various sizes. The natural lighting of the hangar is provided by window openings above the main entrance, which, segmented into smaller fields, extend along its entire length following the arched curvature of the roof plane. The rear part of the central part of the hangar is intended for an office block, while the side annexes contain utility rooms and workshop rooms [71]. In terms of typology, construction techniques, and the innovation of the solution applied in the arching of ample space, the hangar workshop represents one of the most significant buildings in the field of construction engineering of the interwar period in the European and world context [71].

As a result of the construction of more modern and larger airports (near Batajnica in 1951, as well as the “Belgrade” international airport near Surčin in 1962), the Old Airport lost its initial importance and thus its function. Over the years, due to various geo-political events in the country, only a few buildings have been preserved: a hangar workshop, a warehouse and two metal hangars. In 1996, an initiative was launched by the administration of the city of Belgrade to revitalise this facility by introducing new content (permanent exhibitions, preservation of museum collections), which indicates the recognised importance of the Old Airport complex (Figure 14). However, the construction of the AirPort City business centre in the immediate vicinity of the Old Airport hangar, which began in 2005 [73], and as a result of which the hangar was located on privately owned property, further undermined the position of the Old Airport complex as a once extremely important centre of air traffic in the state and region, worth preserving. This attitude towards the monument of technical culture, an essential testimony of traffic development possessing important industrial machines and equipment, indicates that the principles of protecting immovable and movable industrial heritage from international documents [28–30] have not been implemented in practice. On the other hand, since 2013, the hangar has been officially recognized as a cultural monument, re-actualising the topic of its importance [71]. Although defined as an essential part of the industrial heritage of the city of Belgrade, it requires additional protection and revitalisation measures that would enable its better integration into the contemporary context.



Figure 14. Hangar of the Old Belgrade Airport (**Left**—previous state, source: Cultural Heritage Protection Institute of the City of Belgrade, link: <https://beogradskonasledje.rs/wp-content/uploads/2022/01/03-Izgled-kompleksa-starog-aerodroma-cetvrta-decenije-20.-veka.jpg>, accessed on 15 January 2024) (**Right**—current state, provided by authors: students Đekić S. and Mitrović Đ.).

Review of Students’ Proposal for the Revitalisation and Presentation of the Hangar of the Old Belgrade Airport

The students’ proposal integrated all the established principles of industrial heritage protection related to the preservation of its authenticity and adequate presentation of all values to the greatest extent, at the same time, preserving and improving the spirit of the place through the introduction of new complementary purposes from the domain of culture and education. The basic idea of this project includes the revitalisation of the Old Airport

Hangar building into a cultural–educational–entertainment space. The entrance to the facility is located in the side annexe (on the north side), where the exhibition space and its accompanying (service) rooms, catering facilities, as well as a shop for sale and equipping of drones are provided. The central spatial problem is the existence of unevenness around the hangar workshop, which was overcome by providing a staircase on the north side like the one already existing on the south side of the hangar. The proposed solution seeks to activate the rigid zone between the western facade of the hangar and the buried garage space through a spatial organisation that foresees a series of diverse contents along the said facade.

The designed exhibition space envisages a permanent exhibition thematically related to the history of Yugoslavia’s aviation, consolidating knowledge about Yugoslavia’s national material culture. The central area of the facility (hangar) is predetermined to be an extension of the exhibition part. It is adapted to the future function of the space for education through theoretical teaching and practical training of visitors and users in drone management. It is important to point out that the significant height of the central building (over 10 m) allows for this kind of access. In support of this program, there is a gallery space that provides users with the opportunity to view the space from different positions (Figure 15). The spatial capacity of the central part of the building was expanded by adding an outdoor amphitheatre. The southeast side annexe was designed as a space for employees with administrative and other supporting rooms. In order to preserve the value of the original building, the project seeks to preserve the original facade and the machines that participated in the aircraft production within this complex. The part of the building behind the rear facade is intended for projections and presentations, and is separated from the exhibition space, enabling communication and interaction between functions. The outdoor space is covered with greenery and paved paths (Figure 16).

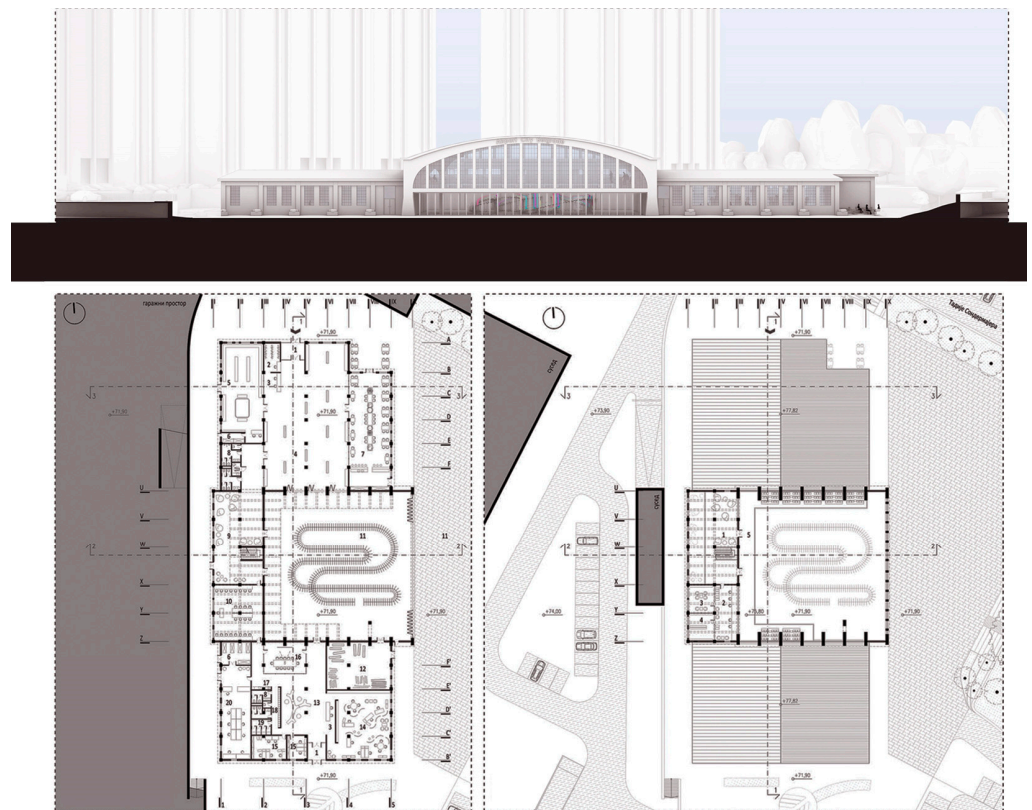


Figure 15. The students’ proposal—technical drawings (drawn by authors: students Đekić S. and Mitrović Đ., 2021).

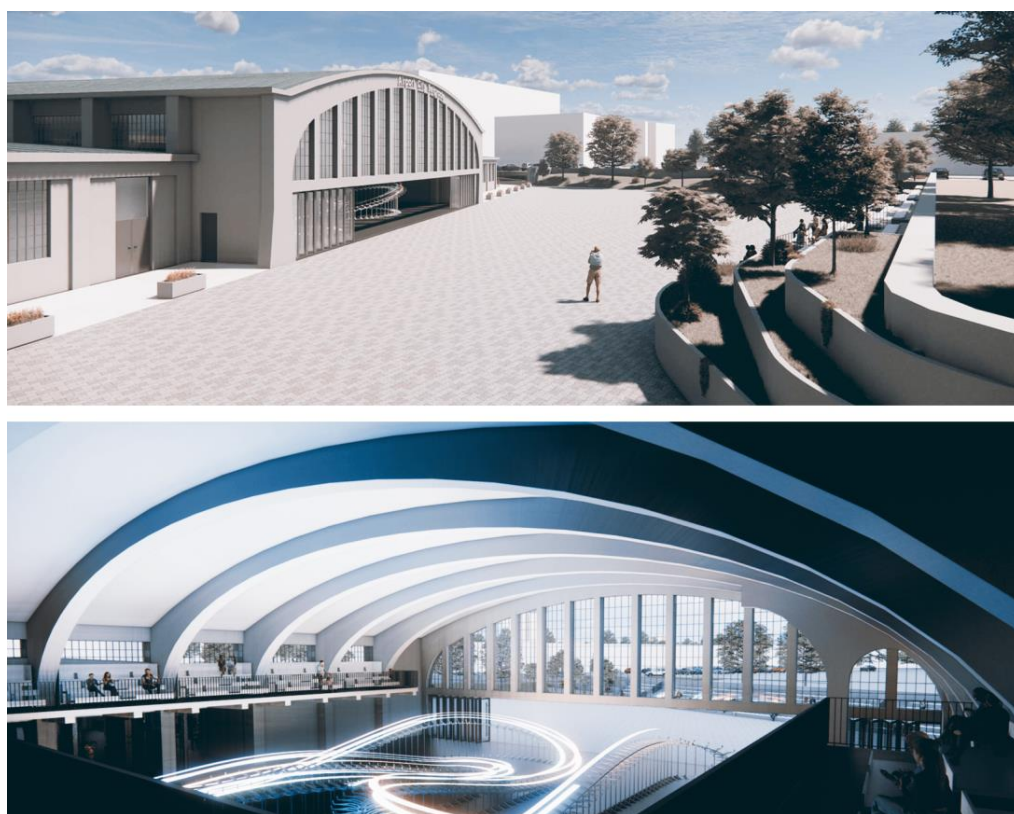


Figure 16. The students' proposal—Ambiental views (drawn by authors: students Đekić S. and Mitrović Đ., 2021).

3.3. The First Modern Garage in Belgrade

The modern garage was built in 1929 and represents the first building of this type in Belgrade, as one of the many realised works of the Russian engineer and architect Valeriy Vladimirovich Stashevsky [74,75]. In terms of form and ideology, the building was designed as a modern building with elements of Art Nouveau and academicism. Over time, the building changed its interior and exterior appearance, but in a significant sense, it preserved its original facade construction, shape and authentic appearance.

The Modern Garage building was conceived in the form of a central hall of a unique spatial volume. The base is trapezoidal. In this regard, the dimensions of the width of the building vary from 21 m to 24 m, while the length of the building is 45.08 m. The main facade of the building is designed symmetrically, and within the central elevation is a monumental entrance bordered by pilasters above which, according to the original project, the sculptures were positioned. On the side elevations, verticality is emphasised by positioning the windows in height in order to get the impression of a continuous one-story building [76].

The original function of the building was changed in 1939 by housing the cars of the participants of the first Belgrade international car and motorcycle race, and later, the function of the building was returned to its original purpose by turning the Modern Garage into a car museum [77]. Based on the recognised cultural–historical, social, architectural, technological and aesthetic values, and considering the fact that it represents the first building with the function of a city garage in the Balkans at that time and the centre of motorsports in Belgrade, it has been enjoying cultural monument status since 1997, according to the decision of the Government of the Republic of Serbia [78].

In addition to the fact that the current purpose of the museum is harmonised with the previous one, which achieved the continuity of the duration of all the inherited values of the technical culture monument, the Modern Garage facility represents a still untapped potential for the regeneration of the industrial heritage of the city of Belgrade following contemporary needs (Figure 17). Moreover, the topic of automotive heritage, its significance and the principles of preservation of historic vehicles need to be included in the broad teaching process, along with an understanding of the specificity of every moveable industrial heritage typology [79,80]. In this regard, the Modern Garage was selected as an adequate case study for examining the possibilities of its protection, revitalisation and presentation, as well as regeneration and adaptation, in accordance with the principles of industrial heritage protection and the infrastructural, technical and technological requirements of contemporary society.



Figure 17. The First Modern Garage in Belgrade (**Left**—previous state, source: The Cultural Heritage Protection Institute of the City of Belgrade, link: <https://beogradskonasledje.rs/wp-content/uploads/2022/09/00-glavna-146-1024x639.jpg>, accessed on 15 January 2024) (**Right**—current state, provided by authors: Nikolić M., Ščekić J., Drobnjak B. and Takač E.).

Review of Students' Proposal for the Revitalisation and Presentation of the First Modern Garage in Belgrade

The students' project envisages the retention of the original reinforced concrete structure of the building, which consists of six reinforced concrete isolated footings and strip footings that continue into eight reinforced concrete columns with a longitudinal spacing of 10 and 15 m, as well as a transverse spacing of 13.5 m. The window openings are intended to be restored in accordance with the original authentic appearance. In this sense, the intervention itself aims to preserve the integrity and authenticity of both the construction and the architectural style, with minimal changes to the original architectural identity of the building (Figure 18).

The project proposes a variety of new uses within the ground floor of the building, such as an open space intended for variable settings and various exhibitions. Spaces for education, workshops and a presentation hall are also planned in this part, with all the accompanying administrative, service and commercial content.

The crucial spatial aspect of the project is the centrally formed ramp inside the building, which, in addition to the function of connecting different program zones within the building vertically, symbolises the former purpose of the building, i.e., the garage, that is, its necessary segment: the ramp with the carriageway.

The proposal for the revitalisation and protection of the Modern Garage building preserves the original dimensions, with the addition of a circular roof intervention that, through an internal ramp, represents the connection between the ground floor and the roof, thus acquiring its intended use. A glass cylinder covers a circular ramp on the roof surface. The new roof structure is conceptually conceived as a flat concrete roof with a circular glass

cylindrical volume structured from thin steel profiles. The ramp itself creates a vertical communication between the ground floor and the roof with a green garden area. Hence, a clear visual difference is made between the original authentic part of the building and the new segments (the most significant are the already mentioned three elements: the centrally positioned ramp, the glass cylinder on the roof level and the roof garden) that complete the building and make it contemporary, both through materialisation and through current architectural style approach.

In this sense, the students' project envisages the activation of the roof area, which then becomes a space for public purposes, in which cultural–educational (amphitheatre, film screenings) and commercial contents (coffee bar) are combined in the open air. The roof plane's greening is planned by adapting its existing concrete surface into a green roof garden (Figure 19).

The revitalisation and presentation project of the Modern Garage aims to reactivate this building in accordance with contemporary methods of revitalisation of industrial buildings and presentation of cultural heritage. With this concept project, the focus is directed towards preserving the integrity and authenticity of the object, its construction and architectural style, as well as through the presence of the original purpose. In this sense, the destruction of the original architectural identity of the building was disabled. The reactivation of the building was achieved through the preservation and modernisation of various contents (workshops, exhibition segments, projection spaces) that document, preserve and show the original character and function of the Modern Garage.

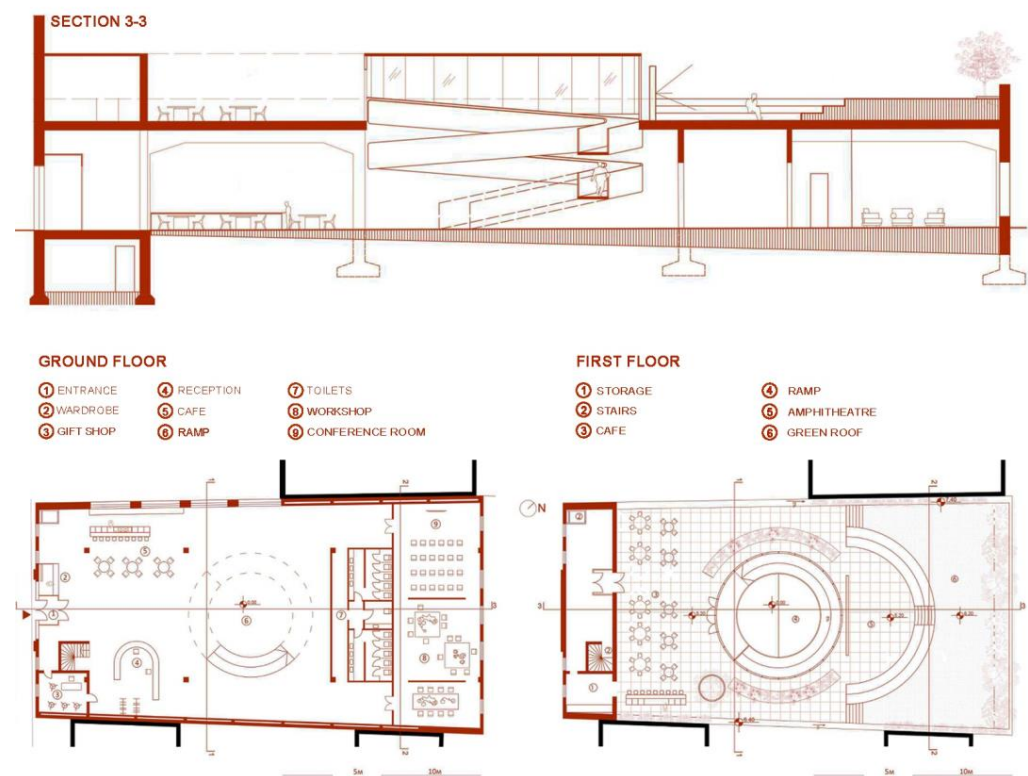


Figure 18. The students' proposal—technical drawings (drawn by authors: students Lukić A. and Ninković I., 2022).



Figure 19. The students’ proposal—Ambiental views (drawn by authors: students Lukić A. and Ninković I., 2022).

4. Discussion

Applicable in Practice: Valorisation of the Research Results

Students’ conceptual solutions for sustainable conservation of industrial heritage, shown through revitalisation projects and presentations of three case studies of Belgrade’s industrial heritage, including The Locksmiths’ Workshop and Foundry “Pantelić”, Hangar of the Old Belgrade Airport and The First Modern Garage, point to the possibilities of simultaneous protection of all the values and authenticity of the industrial heritage, but also to the possibilities of using the industrial heritage as an economic, ecological and social resource in the contemporary context.

Through the defined research methodology, and especially within Phase 1, the focus becomes studying and understanding theoretical principles and concepts in the field of protection, revitalisation and presentation of cultural and industrial heritage, with an emphasis on the preservation of their values and authenticity, but also their sustainable conservation in the contemporary context. In this way, by analysing important documents in cultural and industrial heritage preservation and sustainable development, the students acquired the necessary theoretical knowledge, which was then implemented in their projects for the industrial heritage’s sustainable conservation on concrete case studies in Belgrade.

On the other hand, the need to integrate the industrial heritage into the contemporary context and harmonise it with the contemporary needs and way of living represented the main challenges in the research process and in the formation of the students’ ideas and concepts. Consequently, the imperative to preserve all the inherited values and authenticity of the industrial heritage, alongside the introduction of new spatial and program content in spaces with expressed heritage values and the fitting of contemporary architectural expression into the existing environment while respecting the relationship between the old and the new, are distinguished by all three students’ conceptual solutions presented in this paper.

Although they deal with different case studies of Belgrade’s industrial heritage, which are characterised by different original purposes, all three projects managed to preserve and appropriately present all the values and the authenticity of the analysed monuments of technical culture. They did it alongside the use of contemporary architectural expression and the application of the concept of adaptive reuse, which resulted in successfully

integrating the industrial heritage into the contemporary context. First of all, the existing spatial organisation within the building was mainly preserved, as well as the structural assembly (positions of structural elements, supporting walls and beams) and stylistic features (positions and dimensions of façade openings, decorative plastic (if it existed) and the original authentic dimensions and volume of the building). Furthermore, all three projects envisage the presentation of the previous function of the object through appropriate cultural, educational and exhibition contents, thus ensuring the symbolic continuity of the purpose of the industrial heritage, even in the case when it has been overcome in relation to the contemporary moment. On the other hand, through the concept of adaptive reuse, all three conceptual solutions strive to fit new spatial and program contents concerning the existing environment and values of the monuments of technical culture, but also to symbolically connect the new uses with the previous ones. This is, above all, expressed in the project for revitalising and presenting the Hangar of the Old Airport, by creating a space for training for the management of drones as modern aircrafts. In contrast, the projects for The Locksmiths' Workshop and Foundry "Pantelić" and the First Modern Garage are symbolically connected to the previous purpose of the building through the treatment of the facade with the former cast bells, that is, through the introduction of the ramp as a central motif in the former garage. In the context of establishing sustainable development, all three students' conceptual solutions are characterised by applying contemporary and ecologically acceptable materials in combination with authentic-found ones that are returned to their previous function. Also, all three students' conceptual solutions introduce contemporary sustainable solutions that create additional space quality and promote environmental protection awareness. Both through the attitude towards the inherited values and the recognised need to preserve the authenticity of the industrial heritage, as well as through the character of the newly introduced contents, the use of contemporary materials and the application of sustainable solutions, all three projects respect the existing environment of the building, including its spatial, natural, cultural-historical and social context, but also the spirit of the place, which is preserved through the application of the adaptive reuse concept and improved by introducing new contents that will eventually become a new value of industrial heritage. All aspects of preserving the values and the authenticity of the industrial heritage, as well as the elements of sustainable development applied within each students' conceptual solution for the revitalisation and presentation of Belgrade's industrial heritage, are shown in detail in Figure 20. The tables are designed concerning ten criteria for the valorisation of students' conceptual solutions, defined in Section 2.2.2 of this paper; they indicate the degree of success of students' conceptual solutions to apply theoretical principles and concepts in the field of cultural and industrial heritage preservation and establishment of sustainable development in the practice of industrial heritage's sustainable conservation and its integration into the contemporary context, using contemporary architectural expression.

The students' conceptual solutions represent an alternative future for the analysed monuments of the technical culture, which are currently in the process of devastation and do not enjoy an adequate approach to protecting industrial heritage in the contemporary context. However, although unrealised, projects of revitalisation and presentation of industrial heritage indicate real possibilities for transforming principles and concepts from their theoretical to practical dimension, which was also confirmed through the valorisation of students' conceptual solutions in relation to the defined set of criteria. The presented projects also indicate the success of the research methodology at the University of Belgrade, Faculty of Architecture. Through theoretical teaching and simulation of the practical application of acquired knowledge and skills, young colleagues and future architects become aware of the importance of Belgrade's industrial heritage, its current state and still unused potential for integration into the contemporary context, which they try to use through their conceptual solutions. The education of young colleagues, who will be decision-makers on the quality of the built environment in the future and the status of industrial heritage, is a prerequisite for improving the state of industrial heritage in

Belgrade. However, in order for the industrial heritage of the city of Belgrade to be seen as an economic, ecological and social resource for improving the quality of the living and built environment, it is necessary to expand the awareness of the importance of industrial heritage beyond the academic framework, including experts from other scientific disciplines such as historians, archaeologists, artists, sociologists, anthropologists and psychologists, but also the local population, local government and other stakeholders.

A		CRITERIA 1	CRITERIA 2	CRITERIA 3	CRITERIA 4	CRITERIA 5
		preserving spatial organisation	preserving structural assembly	preserving stylistic features	preserving presenting previous function	preserving integrating into the context
PROJECT 1	Foundry Pantelić	<ul style="list-style-type: none"> the positions of authentic walls and stairs the relationship between outdoor/indoor space the existing floor height inside the building 	<ul style="list-style-type: none"> the positions of authentic columns the positions of authentic beams the positions of constructive walls the visual character of all structural elements 	<ul style="list-style-type: none"> the positions of facade openings the dimensions of facade openings the decorative plastic elements on facade 	<ul style="list-style-type: none"> previous bells' production presented through: exhibition spaces new facade treatment with bells replicas 	<ul style="list-style-type: none"> preservation of the existing object's volume incorporation of a retracted first floor into the existing volume preservation of the existing materials integration of new architectural elements in the existing ambience
PROJECT 2	Hangar of Old Airport	<ul style="list-style-type: none"> the positions of authentic walls and stairs the relationship between the central area and lateral annexes the existing floor height inside the central area the authentic machines 	<ul style="list-style-type: none"> the positions of authentic columns the positions of authentic beams the authentic roof truss the visual character of all structural elements 	<ul style="list-style-type: none"> the positions of facade openings the dimensions of facade openings 	<ul style="list-style-type: none"> previous function in air traffic presented through: the authentic machines exhibition spaces introduction of drones as contemporary aircrafts introduction of drone control training 	<ul style="list-style-type: none"> preservation of the existing object's volume incorporation of a retracted first floor into the existing object's volume preservation of the existing materials integration of new architectural elements in the existing ambience
PROJECT 3	Modern Garage	<ul style="list-style-type: none"> the positions of authentic walls and stairs the existing floor height inside the building 	<ul style="list-style-type: none"> the positions of authentic columns the positions of authentic beams the authentic roof truss the visual character of all structural elements 	<ul style="list-style-type: none"> the positions of facade openings the dimensions of facade openings the decorative plastic elements on facade 	<ul style="list-style-type: none"> previous function of garage presented through: exhibition spaces central motif of the ramp inside the building 	<ul style="list-style-type: none"> preservation of the existing object's volume incorporation of a gallery floor and green roof area into the existing volume preservation of the existing materials integration of new architectural elements in the existing ambience
B		CRITERIA 6	CRITERIA 7	CRITERIA 8	CRITERIA 9	CRITERIA 10
		preserving the spirit of place	defining character of new uses	compliance new uses with the values of the object	applied materials	applied principles of sustainability
PROJECT 1	Foundry Pantelić	<ul style="list-style-type: none"> usage of the authentic constructive materials restoration of the authentic facade usage of new facade materials which are harmonised to the existing ones 	<ul style="list-style-type: none"> exhibition areas educational content (presentation hall, media library, reading room) commercial content (cafe, bookstore, gift shop) gathering areas (terrace, inner courtyard) 	<ul style="list-style-type: none"> High compliance expressed through dominated exhibition areas and symbolic usage of bells in facade treatment, as well as the exhibition exponents 	<ul style="list-style-type: none"> usage of existing authentic materials in combination with new, contemporary ones corten steel perforated tin timber aluminum joinery glass 	<ul style="list-style-type: none"> reuse of existing authentic constructive and architectural elements new materials can be repurposed and reused the inner courtyard improves the quality of space and increases awareness of the environment's importance
PROJECT 2	Hangar of Old Airport	<ul style="list-style-type: none"> usage of the authentic constructive materials usage of new materials which are harmonised to the existing ones the symbolic continuity of previous function through drones 	<ul style="list-style-type: none"> exhibition areas educational content (presentation hall, gallery with telescopic bleachers) commercial content (cafe, drone's store) gathering areas (outdoor amphitheatre) 	<ul style="list-style-type: none"> High compliance expressed through dominated exhibition areas and symbolic usage of drones as contemporary aircrafts, integrated with accompanying contents such as the outdoor amphitheatre 	<ul style="list-style-type: none"> usage of existing authentic materials in combination with new, contemporary ones timber semi-transparent glass steel 	<ul style="list-style-type: none"> reuse of existing authentic constructive and architectural elements new materials can be repurposed and reused the outdoor amphitheatre in greenery improves the quality of space and creates a pleasant natural microambient in the city
PROJECT 3	Modern Garage	<ul style="list-style-type: none"> usage of the authentic constructive materials restoration of the authentic facade usage of new materials which are harmonised to the existing ones the symbolical continuity of previous function through ramp 	<ul style="list-style-type: none"> exhibition areas educational content (presentation hall, workshop area) commercial content (cafe, gift shop) gathering areas (amphitheatre, roof terrace) 	<ul style="list-style-type: none"> High compliance expressed through dominated exhibition areas and the motif of ramp as the symbol of previous function, all connected with accompanying contents such as the green roof 	<ul style="list-style-type: none"> usage of existing authentic materials in combination with new, contemporary ones timber semi-transparent glass natural concrete steel 	<ul style="list-style-type: none"> reuse of existing authentic constructive and architectural elements new materials can be repurposed and reused the green roof area improves the quality of space and contributes to reducing the negative effects of climate change on micro - local level

Figure 20. Valorisation of the students' proposals through the set of criteria (provided by authors: Nikolić M., Šćekić J., Drobnjak B. and Takač E.).

The formation of an interdisciplinary approach to the industrial heritage's sustainable conservation would enable the values and the issue of the authenticity of the industrial heritage to be seen from different scientific disciplines. Moreover, an interdisciplinary approach would enable current problems in the integration of industrial heritage into the contemporary context to be overcome by harmonising new uses with theoretical principles and concepts, but also with the needs of the local community and their preferences, thus ensuring the active use of monuments of technical culture in practice and their survival for future generations. Precisely because of this, the further direction for the improvement of the defined research methodology in the field of sustainable conservation of industrial heritage at the University of Belgrade, Faculty of Architecture refers to the inclusion of experts from other scientific disciplines, the local community and other interested parties in the process of preserving industrial heritage in Belgrade, from theoretical research of a particular case study towards its sustainable conservation in practice.

5. Conclusions

The research methodology presented in this paper, as well as the students' conceptual solutions that represent the results of the applied methodology and the conducted research, indicates real possibilities for the implementation of theoretical principles and concepts in the practice of the sustainable conservation of industrial heritage, while preserving all its values and authenticity, but also fitting the contemporary architectural expression into spaces with pronounced heritage values.

In addition to educating young colleagues and future architects about the importance of industrial heritage on a global level and adequate principles and concepts for its sustainable conservation, the importance of teaching at the University of Belgrade, Faculty of Architecture is also reflected in the fact that students get to know industrial heritage in a local context, analysing the state of monuments of technical culture in Belgrade. Through a combination of theoretical lectures and simulation of the practical application of acquired knowledge on the conceptual projects' development, the students were able to see alternative solutions for the future of the analysed monument of technical culture, which would enable a better integration of the industrial heritage into the contemporary context and its active use.

Furthermore, the study's importance is reflected in the digitalisation of the existing archival material (urban-architectural projects, technical documentation for project's realisation) used to analyse and compare the original authentic and current state of the monument of technical culture. The digitalisation of authentic drawings made it possible to preserve important examples of industrial heritage in Belgrade from oblivion, even if they do not enjoy the appropriate treatment of protection, revitalisation and presentation in preserving the industrial heritage in practice.

In this regard, the further direction of research includes a better integration of different institutions dealing with the topic of industrial heritage preservation in order to carry out existing archival materials and theoretical analysis through an integral and interdisciplinary approach, including experts from different scientific disciplines. In addition to the above-mentioned, the need to involve the local community in the process of industrial heritage's sustainable conservation was recognised, first through analysing their needs and preferences. In order for this to be implemented, further research direction should include additional methodological tools, including questionnaires, surveys and interviews, which would be conducted in cooperation with the local community, as well as relevant experts, based on which insight about real needs and opportunities for their realisation through the practice of industrial heritage's sustainable conservation would be gained. In this sense, the further direction of research includes the expansion of the currently established set of criteria for the valorisation of students' conceptual solutions, which would refer to the degree of fulfilment of the recognised needs of the local community, on the one hand, that is, the degree of fulfilment of theoretical principles and concepts of sustainable conservation of industrial heritage, on the other. Moreover, the question arises of the

applicability of the defined research methodology to other typologies of cultural heritage, such as archaeological, medieval, sacral and modern, which also form an important aspect of the cultural identity of the Republic of Serbia.

Moreover, another topic—the establishment of industrial heritage routes—represents a possible direction for further research. This topic stood out as a consequence of the mapping of industrial heritage in Belgrade, their position and the degree of importance assigned to them, as well as an overview of the relationship between legally protected monuments of technical culture and those that do not officially enjoy that status. The conducted analysis indicates that there still needs to be more commitment to preserving this typology of cultural heritage, both at the local and state levels. Considering the crucial concepts of the sustainable conservation of industrial heritage and, above all, the potential of establishing industrial heritage routes, there are real opportunities for positioning the industrial heritage of Belgrade and the Republic of Serbia on maps of industrial routes, at the local, national, regional and European levels.

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