

INDUSTRIAL HERITAGE AS A DETERMINANT OF A JOYFUL CITY – THE BIM MODELING CASE STUDY OF THE THERMAL POWER PLANT "POWER AND LIGHT" IN BELGRADE

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ABSTRACT

The notion of the joy of a city is a highly provocative and deeply inspiring topic in this study. It is approached from the viewpoint of protection and revitalisation of industrial heritage, the kind of built heritage typical of the majority of contemporary cities. The main statement of the study is that the industrial heritage, often neglected, abandoned and devastated, has a huge potential to significantly contribute to what we call joyful urban environments. The paper commences with examples of such successful revitalisations and reuses that profoundly improve their living contexts (Rome, London and Belgrade).

After reviewing successful examples of adaptive reuse of industrial heritage internationally and in Serbia, we report the ongoing activities of Building Information Modelling (BIM) of the thermal power plant "Power and Light", one of the most beautiful examples of the industrial heritage of Belgrade, the capital of Serbia. The building was operative from the 30s to the late 60s of the last century. Like many similar examples in Europe from the same epoch, although protected, this building has an uncertain destiny, and there are various ideas on how to revitalise and reuse it.

Aiming to understand the building and its complex functionality comprehensively, the BIM modelling has been initiated based on archived documentation saved in the Historical Archive of Belgrade. Prior to the modelling process, a deep examination and digitisation were done, verifying that the archived documentation would be sufficient for the planned BIM modelling. The resulting model is directed towards establishing a web-based digital twin of the power plant, revealing the period of massive industrial, technological and cultural growth in Belgrade and the whole country.

KEYWORDS _ *Industrial heritage, BIM, Building Information Modeling, revitalization, joyful city*

INTRODUCTION

The concept of urban joy constitutes a provocative and profoundly stimulating subject of inquiry (Vanista Lazarevic & Maric, 2025). This study examines it through the lens of the preservation and revitalisation of industrial heritage, a category of built heritage characteristic of the majority of contemporary urban environments (*The Nizhny Tagil Charter, 2012*).

Industrial heritage refers to the physical remains of past industries, including factories, warehouses, mines, mills, railways, and ports. These structures tell the story of technological progress, labour history, and urban transformation. Preserving industrial heritage helps cities to retain a strong connection to their cultural and economic roots. Beyond historical value, these sites often become powerful spaces for creativity, community life, and innovation in modern cities. The adaptive reuse of industrial heritage buildings and the regeneration of former industrial sites are often favoured for their economic, cultural, and historical sustainability (Nepravishta, 2019).

Some studies indicate that research on industrial heritage has significantly expanded in recent years (Bottero et al., 2019; Zhang et al., 2020; Douet, 2012). Figure 1 presents a brief analysis based on the Web of Science (WoS) index, illustrating the substantial increase in the number of scientific publications featuring the term “*industrial heritage*” in their titles over the past two decades.

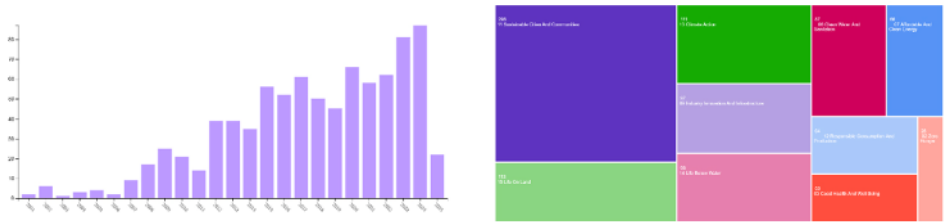


Figure 1: Number of scientific papers on the industrial heritage published from 2001 to April 2025, listed in the WOS Index Base (left), and categorisation of the total number of published works according to Sustainable Development Goals (right).

The bibliometric analysis proceeds by categorising the total number of indexed scientific works (877) according to relevance to Sustainable Development Goals, where about 300 papers belong to the category “Sustainable Cities and Communities.” This suggests that industrial heritage is tightly connected with the sustainability of cities and, more importantly, of local communities and their sense of joyfulness.

Despite the fact that a relatively large number of research works related directly to industrial heritage, only six articles connect industrial heritage with BIM technology (Biagini, Arslan, 2018; Russo et al., 2024; He et al. I, 2015; Crespi et al., 2015; Paris et al., 2023; Gao, Chung, 2024). It indicates that the new technologies have not been sufficiently represented in the industrial heritage protection agenda.

POWER PLANTS AS SPECIFIC REPRESENTATIVES OF INDUSTRIAL HERITAGE AND EXAMPLES OF THEIR SUCCESSFUL REUSE

The initial part of this study is focused on the relationship between industrial heritage and the joyfulness of contemporary cities. It argues that industrial heritage, its treatment, revitalisation, and reuse could be perceived as a determinant of a city’s joyfulness. To analyse the contribution of industrial heritage to a joyful city, a range of power plants on river banks has been selected.

Power plants occupy a unique place within the landscape of industrial heritage. As monumental structures designed to harness and distribute energy, they were once symbols of human progress, technological innovation, and the rapid growth of cities. Architecturally, many power

plants exhibit a surprising degree of aesthetic ambition—vast turbine halls, grand façades, intricate machinery—blending functionality with a kind of industrial grandeur. These buildings are often located in pivotal urban or waterfront locations, making them highly visible and emotionally resonant parts of a city's fabric. As industries evolved and energy production shifted, many of these plants became obsolete, leaving behind enormous, complex spaces that pose both opportunities and challenges. They are powerful reminders of the industrial age, but without careful intervention, they risk falling into decay, becoming barriers rather than bridges within the evolving urban landscape (Añibarro, et al., 2023; Ghosh & Janu, 2011).

The adaptive reuse of power plants presents specific open issues that differ from other types of industrial heritage. Firstly, their sheer scale and robust construction can make renovation extremely costly and technically challenging, often requiring specialised engineering solutions to meet modern standards. Secondly, questions of environmental remediation—dealing with contamination from past industrial processes—add further complexity. Thirdly, finding the right new function is not always straightforward: the vast, cavernous interiors are inspiring, but not all uses can financially or socially justify the immense investment required (Krige, 2010). There is also a cultural tension to navigate: how to preserve the spirit and historical narrative of a power plant while introducing contemporary uses without reducing the space to a mere spectacle. Successful examples of adaptive reuse—such as transforming power plants into art galleries, universities, offices, or residential spaces—show that when handled thoughtfully, these sites can enrich the joyfulness of cities, offering powerful settings for public life that honour both past ambition and present creativity. However, the process remains fraught with debates about authenticity, access, sustainability, and the evolving identity of urban space.

Here are some well-known examples of successful adaptive reuse of power plant buildings and entire complexes (Fig. 2):

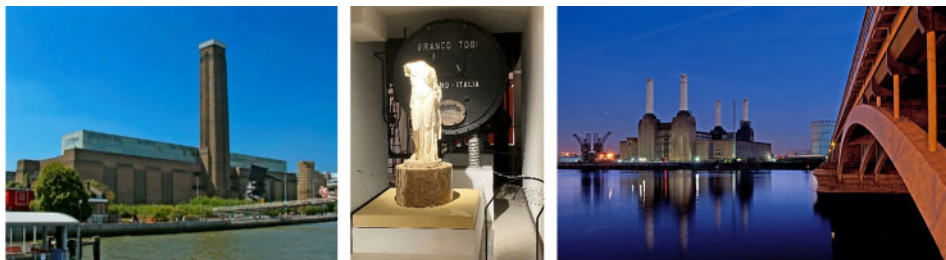


Figure 2: Tate Modern, Left, Source of Illustration (Anon., n.d.); Centrale Montemartini, Middle; Battersea, Right. Source: (Douet, 2023).

Tate Modern

The Tate Modern in London is one of the most famous examples of industrial heritage being transformed into a vibrant cultural space (Fig. 3). It used to be the Bankside Power Station, a giant oil-fired power plant designed by Sir Giles Gilbert Scott and built between 1947 and 1963. Instead of demolishing it when it closed in 1981, the building was brilliantly reimaged (Tate Modern Web Site 2025). In 2000, after a redesign by architects Herzog & de Meuron, it was reopened as the Tate Modern—one of the world's leading modern art museums. What is so powerful is that they kept the raw industrial character, like the massive Turbine Hall, and layered new life into it with art, light, and public space. Now, it is not just a museum; it is a gathering place for locals and visitors, filled with energy and creativity. It shows beautifully how industrial heritage can become a living, joyful part of a city instead of a forgotten ruin.



Figure 3: Tate Modern, London. Photographs by F. Nepravishita (2025).

Centrale Montemartini

The Rome-based Centrale Montemartini is considered a fabulous example of adaptive reuse of the industrial heritage object (Oglethorpe, 2022). This building is a remarkable example of how industrial heritage can breathe new life into a city and contribute to its joyfulness. Initially built in 1912 as Rome's first public power plant, the Centrale Montemartini once symbolised the city's early embrace of modernity and technology. After decades of service, the plant was decommissioned, and like many industrial sites, it stood silent, a relic of a past era. However, rather than demolishing the structure, the city found a visionary new purpose for it—transforming it into a unique museum where classical antiquity meets industrial modernity (Fiore, 2019).

Today, the Centrale Montemartini hosts an extraordinary collection of ancient Roman sculptures (Fig. 4), mosaics, and artefacts dramatically set against the backdrop of enormous diesel engines and industrial machinery. The contrast between the delicate artistry of ancient Rome and the bold power of 20th-century industry creates a space that feels simultaneously timeless and alive. Visitors are invited into a dialogue between different eras, experiencing history not as a distant memory but as something vivid, surprising, and emotionally resonant.

This creative reuse of industrial heritage has added an unexpected layer of cultural richness to Rome, a city already celebrated for its historic treasures. It shows that even in a place so deeply rooted in antiquity, the respectful adaptation of industrial spaces can offer new forms of beauty, reflection, and public delight. The Centrale Montemartini is not only a museum; it is a reminder that joy in cities often comes from the blending of old and new, from honouring the full complexity of urban memory rather than erasing it.



Figure 4: Centrale Montemartini, Rome. Photographs by M. Devetaković (2024).

Battersea Power Station: A Landmark Repurposed

The Battersea Power Station in London stands as a powerful example of how industrial heritage can be reimagined to bring new joy and vitality to a city (Fig. 5). Built between the 1930s and 1950s, the station was once a symbol of industrial strength, providing electricity to a large part of

London. After its closure in 1983, the enormous brick structure, with its iconic chimneys, became a haunting yet beloved landmark. For years, it stood empty as a monumental reminder of a changing economy and the challenges of urban regeneration. Rather than letting it fall into decay or demolishing it, the city chose to transform Battersea Power Station into a vibrant mixed-use neighbourhood. Through careful restoration and imaginative design, the site now hosts shops, homes, offices, parks, cultural venues, and public spaces. The original character of the building—its soaring turbine halls and dramatic industrial forms—has been preserved, giving the entire development a strong sense of identity and history. The rebirth of Battersea Power Station brings joy to London in many ways: it offers a place where people can live, work, gather, and explore, all within an environment that celebrates the city's past while looking to its future. The project shows how industrial heritage can anchor a community's imagination, creating spaces that are not only functional but deeply meaningful. In doing so, Battersea has become a living landmark—a place where memory, creativity, and everyday life meet, making the city feel richer, more dynamic, and more human. "The long-awaited transformation of Battersea Power Station, one of the most ambitious industrial repurposing projects in history, was finally completed in late 2022 in central London. Initially constructed in two phases between 1919 and 1955, the massive coal-fired power station, containing more bricks than any other building in Europe, supplied electricity at full capacity for 25 years before being decommissioned in 1975. For four decades, the fate of this architectural giant remained uncertain, as efforts to adapt it for contemporary use proved challenging. Eventually, a redevelopment plan was devised, balancing conservation needs with a £1.07 billion (€1 billion) investment. Today, the revitalised Battersea Power Station stands as a celebrated success, widely praised for its sensitive restoration and integration into modern urban life" (Douet, 2023).



Figure 5: Battersea, London. Photographs by F. Nepravishta (2025).

CONTRIBUTION OF BELGRADE'S INDUSTRIAL HERITAGE TO LOCAL URBAN JOY

Industrial heritage significantly contributes to Belgrade's contemporary urban experience and the collective sense of joyfulness. As a city characterised by complex historical layers and dynamic transformations, Belgrade's former industrial sites—including riverfront factories, railway infrastructure, and warehouse complexes—serve as vital markers of its socio-economic evolution (Vukmirovic & Nikolic Marko, 2023). These remnants of industrialisation are not merely obsolete structures; they embody the narratives of labour, technological progress, and urban identity. Their preservation and adaptive reuse provide opportunities to strengthen the city's cultural continuity, foster collective memory, and enhance the aesthetic and spatial diversity of the urban environment. Moreover, the presence of industrial heritage offers contrasting textures within the cityscape, enriching public spaces with historical depth and contributing to the emotional and experiential qualities of urban life.

Recent initiatives in Belgrade have increasingly recognised the potential of industrial heritage to foster urban vibrancy and social engagement. The partial revitalisation of the Savamala district (Vanista Lazarevic, et al., 2016), the adaptive reuse of port and warehouse structures along the Sava and Danube rivers, and emerging projects targeting abandoned industrial zones demonstrate a shift towards integrating historical industrial elements into contemporary urban development strategies. Through such processes, industrial heritage sites are reinterpreted as platforms for cultural production, creative industries, and community interaction. Their material authenticity and spatial openness provide settings conducive to experimentation and inclusive public use. In this context, industrial heritage in Belgrade not only preserves significant historical narratives but also actively contributes to creating a more joyful, resilient, and culturally enriched urban experience.

In this study, just a few successful adaptive reuses of the Belgrade industrial heritage are listed:

- Beton Hala (a warehouse zone adapted into different coffees/restaurants district);
- Museum of Science and Technique (old power plant adapted into the museum, Figure 6, left);
- Belgrade Silos (grain tanks adapted into a public space, Figure 6, middle); Old Sugar Factory–KPGT (part of sugar refinery adapted into theatre);
- Old Mill (a mill adapted into a hotel, Figure 7);
- BIGZ Building (adapted into a printing office, Figure 6, right);
- Open Summer Scene (adapted from an old quarry, now abandoned).



Figure 6: The building of the Museum of Science and Technique in Belgrade (left), Source: Wikipedia; The Belgrade Silos (middle), Source: <https://utopiaclimbcommunity.com/utopia-silos-beograd/>; The BIGZ Building (right). Photographs by M. Devetaković (2024).

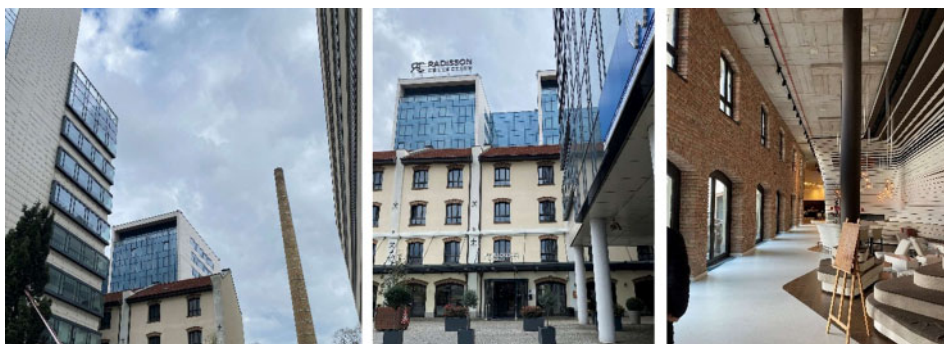


Figure 7: The Old Mill in Belgrade adapted into a hotel and an office building within its complex. Photographs by M. Devetaković (2024).

THE BIM MODELLING OF THE THERMAL POWER PLANT “POWER AND LIGHT” IN THE CONTEXT OF A JOYFUL CITY

The thermal power plant *Snaga i Svetlost* (Power and Light) represents one of the most significant monuments of industrial heritage in Belgrade. Constructed in the early 1930s, it was a significant step in the modernisation of the city's energy infrastructure, providing much-needed electricity to support Belgrade's rapid urban and industrial growth. Located in the lower Dorćol area near the Danube River, the plant was a symbol of technological progress and urban ambition during the interwar period. Architecturally, it combined functional industrial design with elements of modernist aesthetics, reflecting contemporary European trends in utility architecture.

Today, although no longer operational as a power plant, *Snaga i Svetlost* stands as a rare surviving example of early 20th-century energy infrastructure in Belgrade. It embodies not only the city's technical history but also its broader social and economic transformations. Despite its historical and architectural value, the site has faced challenges related to neglect, uncertain future use, and urban development pressures. Its preservation and adaptive reuse represent an important opportunity for Belgrade to integrate its industrial past into a more vibrant and meaningful urban future. In this section, the BIM modelling process of the thermal power plant *Snaga i Svetlost* is contextualised as a specific contribution to supporting the idea of a joyful city. This modelling is taking place in 2024 and 2025 and is still in progress, expected to be concluded by the end of 2025.

The preliminary analysis of the object's technical documentation commenced in the spring of 2024 at the Historical Archives of Belgrade. This process extended over several weeks and involved an in-depth examination of four archival boxes containing original technical documents dating from the 1930s, digitisation, and systematisation of documents (Fig. 8).

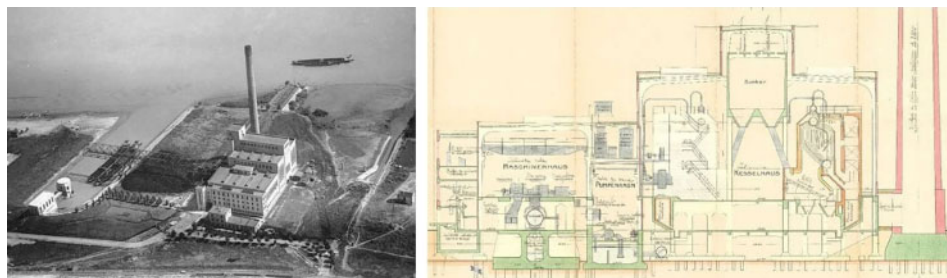


Figure 8: The complex of the power plant “Power and Light” when operative (left), and the original cross-section of the power plant (right).

The modelling process started in November 2024 and was performed by a group of students of the University of Belgrade, Faculty of Architecture. The power plant site and the head office have been modelled so far (Fig. 9). Due to the massive student protests in Serbia and the closure of the University for several months, the modelling process experienced inevitable stagnation compared to the planned dynamics.

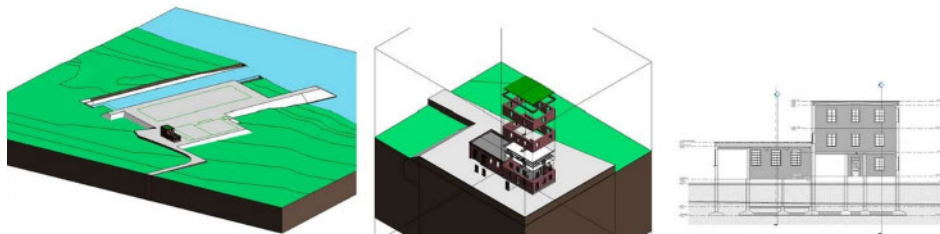


Figure 9: The complex site (left) and the head office (middle and right) of the power plant “Power and Light” in Belgrade, BIM model, as of May 2025.

Nevertheless, the collection and examination of archived documentation, its digitisation and systematisation, and the initial BIM modelling contribute to a better understanding of the industrial past, its appearance, structural characteristics, and functioning. These processes also help to understand the full potential of the spaces and to predict their possible future use.

CONCLUSIONS

The paper addresses the concept of urban joy through the lens of industrial heritage preservation and adaptive reuse, positioning such heritage as a catalyst for enhancing emotional and spatial experiences in cities. By analysing international examples such as Tate Modern in London, Centrale Montemartini in Rome, and Battersea Power Station, the study demonstrates how former thermal power plants—once symbols of industrial development—have been successfully revitalised and transformed into dynamic public spaces that enrich urban life.

Focusing on the industrial heritage of Belgrade, the study examines several successful examples of adaptive reuse, including the Old Mill, the Museum of Science and Technology, and the BIGZ building, which has been transformed into museums, theatres, hotels, restaurant areas, and artistic community centres. These cases emphasise the city's growing awareness of its industrial past as a cultural and spatial asset that can contribute to safeguarding identity, promoting social interaction, and cultivating a sense of belonging.

Based on archival documentation, the BIM modelling of industrial heritage buildings can be considered a valuable contribution to their better understanding. It also represents a preliminary step in any revitalisation or adaptive reuse process. Publishing these models online, in the form of unique digital twins, not only preserves the technical and historical characteristics of the structures but also helps raise awareness and pride among citizens regarding the history of their cities.

The BIM modelling of the Snaga i Svetlost thermal power plant—one of the most emblematic structures of industrial heritage in Belgrade—is a highly demanding and ongoing process based on research and archival documentation from the 1930s. It provides a digital foundation for future revitalisation efforts and the development of an online digital tour accessible to the citizens of Belgrade and other interested parties. By intertwining heritage and technology, this research illustrates how BIM can serve as a strategic tool for both conservation planning and the reactivation of heritage assets. Such approaches allow industrial heritage to transcend static preservation and become an active contributor to the contemporary vitality of the city.

In conclusion, it can be argued that the integration of industrial heritage into urban narratives—supported by digital tools such as BIM—can foster more joyful, inclusive, and culturally rich urban environments. Recognising and reintegrating these witnesses of industrial heritage can serve as key elements in shaping identity and joy in cities like Belgrade.

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