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Adaptive Reuse of Industrial Buildings as Public Libraries

Adaptacja obiektów przemysłowych na biblioteki publiczne

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Słowa kluczowe: renowacja obiektów przemysłowych, biblioteki publiczne, efektywność energetyczna

Introduction

At present, the construction of public libraries is associated with the development of the urban structure and with the renovation of industrial facilities for public uses. The renovation of industrial facilities implies a set of measures aimed at socializing abandoned areas, improving urban infrastructure as a factor in urban renewal and raising the standard of living of a city's residents. Due to the fact that present-day cities develop extensively, abandoned buildings—depressive in economic, urban-planning and social terms—will be adapted to public uses, open to all institutions, especially libraries. The sites for the revival of urban areas are industrial buildings, which carry a significant layer of our history. Libraries often occupy heritage sites and industrial historical buildings, serving as a component of urban renewal projects and as a successor to histor-

ical heritage. This practice contributes to the strengthening of a favorable image of the city by increasing the level of education, culture and upbringing of the population.

Review of the literature

The theoretical basis for this study consisted of fundamental works, articles and essays on the adaptive reuse of industrial facilities and the design of public libraries of Ukrainian, Russian and other foreign researchers. The adaptive reuse of closed-down industrial facilities for public and residential functions was discussed in the works of Yu.A. Suprunovich [Suprunovich 2006], O.A. Popova [Popova 2013], Yu.V. Ivashko and M. Orlenko [Ivashko and Orlenko 2019], and N.O. Dmytryk [Dmytryk 2020]. The preservation of industrial heritage was explored by Alex

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Föhl [Föhl 1996], M.S. Stieglitz [Stieglitz 2003], and Bartosz M. Walczak [Walczak 2016]. The issues of the spatial organization of public libraries was investigated in the works of T. Ito [Ito 2010], M.V. Puchkov [Puchkov 2010], K.E. Trubetskov [Trubetskov 2005], and O. Dubinina [Dubinina 2014].

The remodeling of library buildings and spaces was studied in the works of such authors as A.M. Zhugastr-Lushina [Zhugastr-Lushina 2014], H.A. Voytsekhivska [Voytsekhivska 2008], G.A. Kislovskaya [Kislovskaya 2009], and T.S. Rumilets [Rumilets 2016]. Energy efficiency issues in library design were discussed by Petra Hauke, Karen Latimer, Klaus Ulrich Werner [Hauke et al. 2013].

Methodology

The methodological basis for this study consisted of an integrated approach, with the help of which the object of research was explored as an element of a single urban planning system.

The following methods were used in the work:

- system analysis was used to trace the development of new functions in unused industrial facilities in connection with the transition from an industrial society to an information society;
- comparative analysis was used to identify distinctive features in the architecture of libraries that are formed in the context of industrial building adaptive reuse;
- historical chronology made it possible to sequence the material in its genesis;
- deductive and inductive techniques were used for the integrated synthesis and organization of data and the results obtained as a whole.

A graphical-analytical method was used to identify commonly used types of industrial buildings adapted into libraries.

Preconditions for the emergence of new functions in industrial facilities

The change in the socio-political structure of society, namely the entry of our civilization into the information stage, caused some countries to enter a process of varying de-industrialization, which led to the closing of a large number of industrial enterprises. In Ukraine, this process has taken on gigantic proportions. The decline of city-forming enterprises, unused industrial sites, the lack of an architectural and aesthetic interconnection with residential areas negatively affected both the spatial characteristics and the competitiveness of cities [Dmytryk 2020].

New socio-economic conditions led to extensive urban sprawl. At the same time, there is a lack of complexity and balance of new development, the predominance of point construction, and the presence of decayed industrial areas is accompanied by property stratification of the urban population.

The renovation of industrial facilities implies a set of measures, as a result of which closed industrial plants acquire public, residential or mixed functions.

The renovation of industrial facilities, from the point of view of environmental safety, can move in two directions: improving the environmental situation by eliminating an industrial structure, with reclamation of the territory, if necessary, with the introduction of new public facilities, or a complex solution that implies the preservation of historical and typical buildings and structures, adapting them to new uses, including public libraries, and using natural landscape design methods for landscaping. The second method is more acceptable, since it allows one to preserve the historical background of the city.

Types of industrial facilities undergoing renovation for public libraries

Analysis of theoretical works in the field of reconstruction and renovation of industrial facilities, as well as practical experience, allowed us to assert that there is a relationship between the characteristics of an industrial facility and the type of new use introduced into it.

For library complexes, both historical and typical buildings are often used. The first type includes monuments of history, architecture, and unique structures. The second type includes structures that are not of aesthetic value, but have good architectural, spatio-planning and design indicators. Depending on which type a building or a complex belongs to, grounds are created for taking an optimal direction of renovation [Dmytryk 2020].

Masonry industrial buildings with one or two floors, a span or hall structure and pitched roofs are often used. One example of the use of such buildings is the public library in Hirosaki, Japan. The library is part of the Hirosaki Museum of Contemporary Art (MOCA). The museum is located in a historical single-story brick building with a hall structure, which housed a brewery and later a cider production plant. The complex features not only exhibition halls and a library, but also a creative studio, a shop and a cafe. The old plaster was removed to reveal the original masonry and incorporate it into the interior solutions.

For the library function, single-story buildings with high spaces and, for example, a gallery layout, are also used. One example of such a facility is a public library based on an old wine warehouse in Bogotá, Colombia. The building, open on three sides, is 78 m long and 10.5 m wide, and its total area is 821 m².

Inside, a gallery was arranged without disturbing the original structure of the building, in order to preserve and incorporate the original fittings into the overall structure. The renovated warehouse also sports a music school.

The adaptation of a historic hall-style building resulted in the establishment of the Cornell University Library in Ithaca, New York, which is housed in a century-old industrial warehouse.



Fig. 1. Public library in a former brewery in Hirosaki, Japan, 2020; photo by D. Ano [https://www.archdaily.com/944783/hirosaki-museum-of-contemporary-art-atelier-tsuyoshi-tane-architects?ad_source=search&ad_medium=search_result_all].

Ryc. 1. Biblioteka publiczna w dawnym browarze w mieście Hirosaki w Japonii, 2020; fot. Daici Ano [https://www.archdaily.com/944783/hirosaki-museum-of-contemporary-art-atelier-tsuyoshi-tane-architects?ad_source=search&ad_medium=search_result_all].

The library is housed on the top two floors of the renovated facility and features ultramodern equipment with enormous stacks of books in the center, digital resources and extensive reading and study materials. The library holds 125,000 volumes in the form of an inverted two-story book ziggurat, with stacks accessible by stairs and walkways.

Typical multi-story frame buildings are also used. For example, in Strasbourg, Segmüller's warehouses, located in the port area, have been converted into a modern public library. The warehouse was preserved as a vertical landmark in the landscape, marking the entrance to the port area from the side of the old town. The project retained the magnificent concrete structures. The extension is a vertical and horizontal ex-



Fig. 2. Library in a former warehouse in Bogotá, Colombia, 2010; photo by F. Alda [<https://www.archdaily.com/140377/public-library-and-music-school-donaire-arquitectos>].

Ryc. 2. Biblioteka w dawnym magazynie w Bogocie w Kolumbii, 2020; fot. F. Alda [<https://www.archdaily.com/140377/public-library-and-music-school-donaire-arquitectos>].

tension, perfectly aligned with the original structure. The library occupies the first five floors with spacious reading rooms, while the upper levels are occupied by administrative and service facilities.

In the evening, the interior spaces of the reading rooms offer a spectacular view from the two banks of the river. The library in the former Siegmüller warehouse building has become a symbol of the city's waterfront.

Another interesting example is the renovation of a former steam locomotive depot, located next to the train station in the Dutch city of Tilburg, which was redesigned into a large library complex, with co-working spaces, rooms for communication and various events.

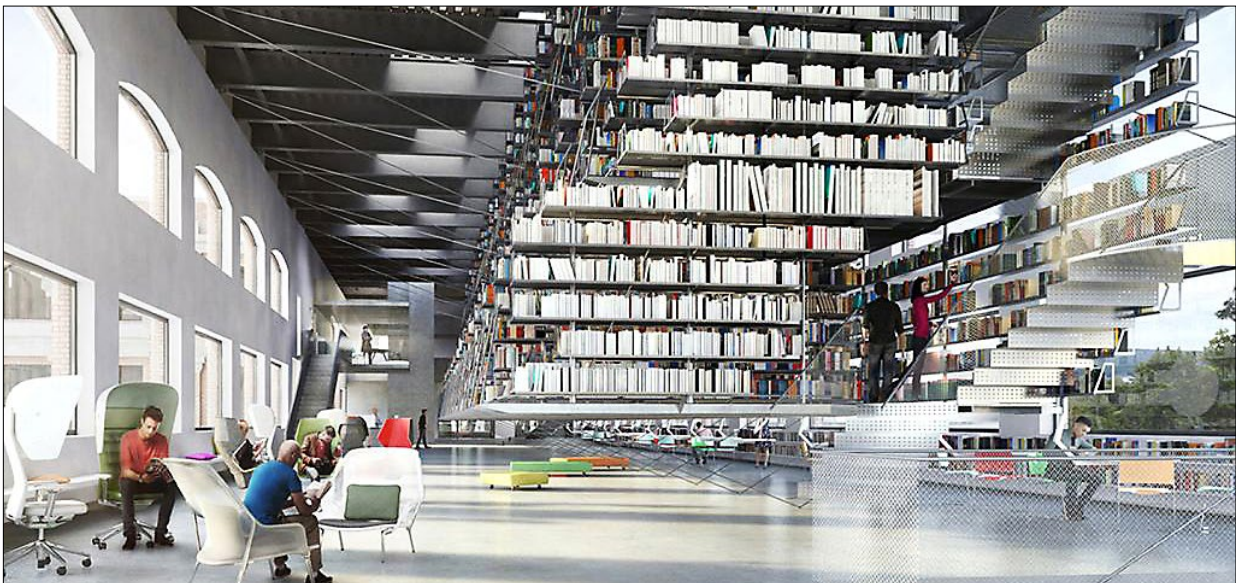


Fig. 3. Cornell University Mui Ho Fine Arts Library arranged in a former warehouse in Ithaca, NY; by W. Tschapeller [<https://aap.cornell.edu/news-events/construction-begins-mui-ho-fine-arts-library>].

Ryc. 3. Budynek Mui Ho Fine Arts Library należący do Cornell University, urządzony w dawnym magazynie w mieście Ithaca w stanie Nowy Jork; obr. W. Tschapeller [<https://aap.cornell.edu/news-events/construction-begins-mui-ho-fine-arts-library> 2021].



Fig. 4. Library in former Segmüller warehouses, Strasbourg; photo by D. Boudet [<https://www.architonic.com/en/project/jean-marc-ibos-myrtovitar-the-andre-malraux-library/5101723>].

Ryc. 4. Biblioteka w dawnych magazynach Segmüller w Strasburgu, fot. D. Boudet [<https://www.architonic.com/en/project/jean-marc-ibos-myrtovitar-the-andre-malraux-library/5101723>].

In the vast space of the ex-locomotive depot, three library projects were gathered: the Bibliotheek Midden-Brabant public library, the regional science center for art and culture Kunstloc Brabant, and the investment fund Brabant C, which operates in the creative industry.

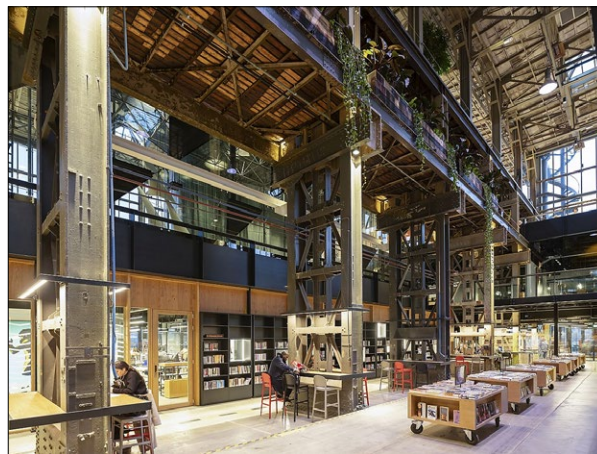


Fig. 5. Library in a former locomotive depot in Tilburg, the Netherlands, 2016 [http://www.redeveloper.ru/redeveloperskie-proekty/realise_actual/gorodskaya-gostinaya-lochal-v-tilburge-niderlandy/].

Ryc. 5. Biblioteka w dawnej zajezdni lokomotyw w Tilburgu w Holandii, 2016 [http://www.redeveloper.ru/redeveloperskie-proekty/realise_actual/gorodskaya-gostinaya-lochal-v-tilburge-niderlandy/].

Storage structures are also used in adaptive reuse projects. One example of such a structure is the brick water reservoir in Barcelona, built with the participation of Gaudi in 1874 and redesigned as a library a few years ago. The facility is located in Ciutadella Park; a building with high arches, on the roof of which there was a reservoir with a capacity of 15,000 m³, which was used to store water for irrigating the park. At present, this building houses the library of the University named after Pompeu Fabra. Brick pylons 1-m-thick and 14 m high support the arches with a span of 4 m. The walls have massive openings to save building materials. As a result, the image of the building resembles an ancient Roman reservoir. Subsequently, it was the large openings in the walls, thanks to which a large amount of



Fig. 6. Library in a former water reservoir in Barcelona; photo by S. Garcia [https://architime.ru/specarch/josep_fontsere/universitat_pompeu_fabra_library.htm#1.jpg].

Ryc. 6. Biblioteka w dawnym zbiorniku na wodę w Barcelonie; fot. S. Garcia [https://architime.ru/specarch/josep_fontsere/universitat_pompeu_fabra_library.htm#1.jpg].



Fig. 7. Reading room as part of an art center in a former water tower, Mariupol, Ukraine; unknown author [<https://dn.depo.ua/rus/mariupol/simvol-mariupolya-yak-starovinnu-vezhu-peretvoryuyut-na-kulturniy-22012017100000>].

Ryc. 7. Czytelnia, część centrum sztuki w dawnej wieży ciśnieni w Mariupolu u Ukrainie; autor nieznany [<https://dn.depo.ua/rus/mariupol/simvol-mariupolya-yak-starovinnu-vezhu-peretvoryuyut-na-kulturniy-22012017100000>].

natural light penetrates into the structure, that made it possible to place the library here. The collection of the library today consists of 573,786 volumes.

The former Rocca tobacco factory in Denzlingen was adapted into an information and library center (2004) and is an immensely interesting project. The premises of the factory were remodeled, while the architects retained the old facade, interior decoration of the premises, forged interior details, adding modern equipment in order to link the “information” future with the “industrial” past. In Hamburg, the main branch office of the Hoeb4U youth library is also located in a building that used to house a factory. Renovation work on it was carried out in 2005. The design of the library, intended to be appealing to youth, is emphasized by chrome shelves, soft sofas and ottomans, and distinctive lighting techniques. The core of the library is a bar, around which computer stations are set up.

In Ukraine, the renovation of industrial facilities usually occurs in a pointwise manner, without the development of a general urban planning concept. Most often, industrial buildings are used for retail, office and museum functions. However, there is the interesting case of the use of a historic water tower as a branch of a library as part of an art center in Mariupol.

Analysis of references and practical experience in the design of libraries based on the adaptive reuse of industrial facilities suggests that both typical buildings and historically significant ones can be used as libraries; by design features, these can be buildings with wall, wall-and-frame, frame and spatial schemes; in terms of story number, such buildings can be used as single-story, two-story, and multi-story facilities; according to an architectural and artistic view, historical buildings made in the masonry factory style are most often used; in addition to masonry material storage buildings.

Issues of environmental safety and energy efficiency in the design of libraries as a part of industrial building adaptive reuse

The degree of pollution of an industrial site determines the need for the biorecoupling of land, and identifies the possibility of eliminating pollution and carrying out landscaping, irrigation, creating self-regulating ecological systems, and also indicates the possibility of reuse. Assessment of the potential of inactive industrial area for the introduction of new forms of use leads to the sustainable development of the ecological environment of the city.

Design solutions should be aimed at minimizing renovation and maintenance costs (in particular, electricity and heating), following the principles of green architecture.

An important means for the development and recovery of urban ecosystems is the use of environmental elements such as flora. Greening flat roofs, the use of elements of the biological environment in architecture and interiors, is given significant attention for this reason. Live plants, water, stone, materials that imitate the texture of wood, fragments of certain natural zones with a stable microclimate, etc. are used. Due to the fact that industrial facilities were often sited in the best urban areas (near water bodies, surrounded by green spaces, port areas, etc.), the renewal of the ecological balance in these areas is extremely important for the renewal of the vital component of the city.

During forming libraries based on the renovation of industrial buildings, the following methods should be used to improve the environmental safety and energy efficiency of the renovated facilities:

- optimal „effective” planning and design solutions, favorable orientation of functional facilities to the cardinal direction, maximum use of natural light by including an atrium or seamless glazing into the building structure, or, conversely, using controlled sun protection;
- use of rainwater collection systems, treatment systems and recycling industrial water;
- the use of an energy-saving climatic heating system, natural ventilation and air conditioning;
- the use of alternative energy sources: solar panels made of environmentally friendly materials, which can then be reused and recycled;

- improvement of “intelligent” systems of automatic building maintenance and energy-saving artificial lighting technologies;
- insulation of external walls, if necessary, using modern composite materials [Rumilets 2016].

A prime example of the above techniques is the Cornell University Library in Ithaca, New York, which is housed in historical industrial warehouses. In the building, significant energy savings are achieved through modernization, which included insulating the building with rigid foam, installing insulating glass around the entire perimeter of the outer walls and replacing all engineering systems with the predicted goal of reducing the existing energy consumption of the renovated facility by 70% [Aloi 2018].

During the renovation of a brick water reservoir in Barcelona, it was the large openings in its walls, thanks to which a large amount of natural light penetrates into the structure, that made it possible to place a library in it. Energy saving was the driving force behind the project. The interior layout planning and zoning of the premises was decided in such a way as to make the most of daylight. It is estimated this allowed for achieving an energy savings rate of 22.8%.

Conclusions

An analysis of the experience of renovating industrial facilities has shown that there is a practice of placing new functions in industrial facilities with an appropriate planning layout system, and in facilities that do not have relevant indicators, but are unique or have historical significance.

The method of analysis and generalization made it possible to identify two types of library design based on renovation: buildings specifically adapted into libraries, or libraries integrated into a wider array of uses.

The use of energy-efficient technologies to create libraries with low energy consumption on their basis is an important task during the renovation of industrial facilities. Here, the efficient use of energy is achieved through the use of economically justified innovative solutions.

The historical and cultural factor influences the formation of libraries by the existing intangible features of an industrial facility [the peculiar industrial “spirit” of a site, its historical and cultural value and social status]. The identification of these features, their use in the implementation of new functions contributes to the preservation of the cultural and historical heritage, increases the prestige of the library.

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Abstract

This paper discusses the problem of closed-down industrial plants in urban structures, and the prerequisites for the emergence of new uses in them, with a specific focus on libraries. The issues of the interconnection between the architectural and planning solution of the building undergoing adaptive reuse and the library function were explored; the importance of the intangible component of the renovated industrial facility in the context of the formation of the prestige of the public library and the preservation of the historical component of the urban structure was discussed. The study identified the types of industrial buildings suitable for adaptive reuse as libraries, and explored the issues of energy efficiency and environmental safety of the formation of libraries based on renovation. The authors investigated a range of problems that arise during the adaptive reuse of industrial buildings that have various degrees of architectural, artistic and historical significance. Major renovation directions were also described from the position of ecological safety.

Streszczenie

W pracy omówiono kwestię zamkniętych zakładów przemysłowych w strukturze miejskiej, przesłanki dla powstania w nich nowych funkcji, zwłaszcza bibliotek. Rozpoznano związki pomiędzy układem przestrzennym adaptowanego budynku i funkcją biblioteki, podkreślono znaczenie komponentu niematerialnego adaptowanego budynku w kontekście kształtowania prestiżu biblioteki i zachowania struktury urbanistycznej. Przebadano rodzaje budynków przemysłowych adaptowanych na cele bibliotek publicznych oraz przedstawiono kwestie efektywności energetycznej i bezpieczeństwa ekologicznego tworzenia bibliotek w ramach adaptacji budynków istniejących. Rozpatrzono niektóre kwestie wynikające z adaptacji do nowej funkcji budynków przemysłowych o różnym stopniu znaczenia architektonicznego, artystycznego i historycznego. Opisano główne kierunki renowacji z punktu widzenia bezpieczeństwa ekologicznego.