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ARCHITECTURE FOR ANIMALS: FORM AND TECHNOLOGY

ARCHITEKTURA DLA ZWIERZĄT – FORMA A TECHNOLOGIA

Abstract

The aim of this study is to discuss finished projects of buildings, aviaries and enclosures for animals in zoos, especially those built in recent years. Literature research and *in situ* analysis of the projects prove that the development of construction techniques and technologies have an impact on animal welfare in zoos. The technology contributes to maintaining an appropriate climate for animals and also influences the architectural form of buildings.

Keywords: animal buildings, zoos, construction technologies, climate adaptation, architectural form

Streszczenie

Celem pracy jest omówienie realizacji obiektów, wolier i wybiegów dla zwierząt w ogrodach zoologicznych, zwłaszcza tych powstałych w ostatnich latach. Badania literaturowe i analiza realizacji *in situ* dowodzą, że rozwój technik i technologii budowlanych mają wpływ na dobrostan zwierząt w ogrodach zoologicznych. Technologia przyczynia się do zachowania odpowiedniego dla zwierząt klimatu, a także wpływa na formę architektoniczną obiektów.

Słowa kluczowe: obiekty dla zwierząt, ogrody zoologiczne, technologie budowlane, dostosowanie do klimatu, forma architektoniczna

1. INTRODUCTION

This paper discusses the evolution of enclosures and outdoor aviaries as well as animal exhibition pavilions in zoos in the early 21st century. The detailed area of research is limited to the territory of Poland, where, due to the possibility of obtaining European funds, since 2004, after years of stagnation, there has been a rapid development of these institutions. The background for the discussion will be a short description of the trends and methods of exhibiting animals in zoos, based on the examples of selected modern structures in global and European institutions, which is related to the change in the paradigm of their operation at the end of the 20th century.

The research goal is to demonstrate that the latest technological solutions are successfully implemented in this type of buildings. This contributes to improving the conditions of the animal species that live there, often from biotopes distant from the exhibition site, mainly by creating and maintaining artificial climatic conditions as close to natural as possible. At

the same time, this tendency affects the forms of pavilions and outdoor exhibitions, which at the turn of the 20th and 21st centuries resemble futuristic shapes and high-tech installations, or – on the contrary – minimalist background architecture. In all of them, elements of nature come to the fore, allowing one to observe animals in conditions imitating their habitat.

2. A SHORT HISTORY OF ZOOLOGICAL GARDEN ARCHITECTURE

The origins of modern zoos can be traced back to the ancient menagerie of nobles,[1] but primarily to the times of the Enlightenment, when many of them were opened to the public.[2] Throughout the 19th century, new institutions, open to the wider public, were established in the cities of rich countries in Europe and the Americas. Traveling menageries, known from medieval times, were still in operation. Originally, they were intended primarily to be places of entertainment, where wild, exotic animals were exhibited as a kind of peculiarity, curiosity or symbol of the economic and colonial success of a city or country. However, the welfare or well-being of animals was often not taken into account at all.

Therefore, the cages and enclosures were relatively small to allow visitors to get as close as possible to the 'exhibits'. Their architecture corresponded to the fashions and styles prevailing in a given period. The late Baroque spatial arrangement of the Vienna Zoo together with the calm architecture of the pavilions bordering on classicism is one of the most valuable elements of the Schönbrunn park and palace complex.[3] Gothic, Baroque, Byzantine, Classical Revivals, eclectic and Art Nouveau pavilions in other zoos in Europe and America were also considered monuments, most often covered by various forms of protection. The increasingly common use of glass and cast iron in architecture since the second half of the 19th century has left behind many interesting pavilions and greenhouses used to display various species of animals and plants in zoos.[4] All of them, along with other monuments, contribute to the architectural and urban heritage of cities and metropolises.

A characteristic feature of the architecture for animals in zoos were the often used 'exotic', primarily oriental, elements of architectural decorations[5] or interior design of pavilions, which were to emphasize the origin of the species exhibited there. Sometimes animal motifs were also depicted on buildings, fences and grates of enclosures (preserved to this day, e.g., in zoos in Berlin and Wrocław).

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[1] The oldest still operating zoo in Europe and the world is the former imperial menagerie – Tiergarten Schönbrunn in Vienna, founded in 1752 and opened to the general public 20 years later. (Vienna zoo, *https://www.zoovienna.at* (access: 03.11.2023); also: O.B. Fekete, K. M. Szilágyi*, Contemporary zoo design and the historical treasure of garden art: Tiergarten Schönbrunn*, "Journal of Landscape Architecture" 2021, no. 16(3), pp. 82–93. DOI: 10.1080/18626033.2021.2046809 access: 5.11.2023).

[2] M. Adamska, *Ogród zoologiczny w Opolu. Harmonia świata zwierząt i roślin = Zoological Garden in Opole. Harmony of Plants and Animals*, "Teka Komisji Urbanistyki i Architektury w Krakowie" 2017, vol. 45, pp. 169–179.

[3] O.B. Fekete, K.M. Szilágyi, *op. cit*.

[4] Pavilions at the Bronx Zoo and Central Park Zoo in New York, the Monkey House at the Vienna Zoo, and the Aviary at the Wrocław Zoo – the author's *in situ* observations.

[5] They are still present today in historic, preserved facilities, including the Bronx Zoo in NYC, Berlin, London, and in Poland, the Old Zoo in Poznań and Wrocław (the two oldest facilities of this type in the country).

The architectural heritage of modernism is also present in zoos around the world, both the original international style of the interwar period and 'Late Modernism' from the second half of the 20th century, when many buildings were expanded or rebuilt after the destruction of World War II.[6]

The most characteristic work of 'prime' Modernism in zoos is the Penguin Pool[7] from ZSL London Zoo, considered an icon of British Modernist architecture, designed by Berthold Lubetkin together with the London Tecton group and put into use in 1935. The oval pavilion, inspired by a double helix, implements four of Le Corbusier's five principles: an open plan, a free façade, horizontal strips of windows (mainly openings) and pilotis. Since 2004, the building has no longer served as an exhibition of penguins, serving only as a monument, a symbol of the zoo, which brings it closer to Loos's definition of architecture, which has been repeatedly recalled.[8]

3. TOWARDS A MODERN ZOO: BIOLOGY, ARCHITECTURE AND TECHNOLOGY

In the second half of the 20th century, there was a paradigm shift and zoos became primarily research institutions and reserves of endangered species, in order to preserve them for posterity and, if possible, restore them to nature.[9] The number and diversity of species exhibited in the zoo is no longer the main priority, and the recreational and entertainment function of the buildings is balanced by their educational and conservation activities.[10]

Currently, animals are most often displayed in pavilions and enclosures whose buildings imitate natural conditions. Modern research in the field of zoology draws attention to the existential needs of animals in zoos – both physical and mental, which together aim to ensure their well-being.[11] The small areas of pavilions, enclosures and aviaries, as well as constant direct contact with visitors, popular in the early days of the existence of widely available menageries and zoos, were not such factors.

Architecture plays a key role in providing larger, more welcoming spaces for zoo animals. Understood as the art of creating space, both on a micro scale: a detail, a room and an object, and on a macro scale: a complex of buildings, an area, a park-zoo. Technology is also extremely important: modern, innovative materials, systems, construction technologies and techniques, as well as operating devices that contribute to maintaining appropriate climatic and lighting conditions.

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[6] C. Jencks, *Ruch nowoczesny w architekturze,* WAiF, Warszawa 1987.

[7] J. Gellner, M. Boczar, *Architektura i zwierzęta*, Wydawnictwo EMG, Kraków 2021, pp. 171–173.

[8] See: T. Kozłowski, *Architecture and art*, Wydawnictwo Politechniki Krakowskiej, Kraków 2019.

[9] The tasks and principles of operation of zoos are specified in many international agreements and documents, promoted and adopted by numerous organizations, the leading ones being: WAZA World Association of Zoos and Aquariums – https://www.waza.org/ and EAZA – European Association of Zoos and Aquariums– https://www.eaza.net/ (access: 10.01.2024).

[10] S.L. Spooner et al., *The value of zoos for species and society: The need for a new model*, "Biological Conservation" 2023, vol. 279, art. no. 109925. DOI: 10.1016/j.biocon.2023.109925 (access: 10.01.2024).

[11] See e.g.: C. van Tuyl (ed.), *Zoos and animal welfare*, Greenheaven Press, Detroit 2008; R.J. Young, *Environmental enrichment for captive animals*, Blackwell Science Ltd., Oxford 2003; S.P. Hill, D.M. Broom, *Measuring zoo animal welfare: theory and practice*, "Zoo Biology" 2009, no. 28(6), pp. 531–544. DOI: 10.1002/ZOO.20276 (access: 12.01.2024).

A flagship example of a system used in many buildings in zoos around the world is the curtain wall, evolving from a simple cast iron and glass system to modern, multi-layer, multi-material, intelligent technological systems.[12] Others are shell and tie structures, enabling the creation of spacious, dynamic aviaries and the roofing of spacious pavilions. But new, energy-saving building materials (including insulation) are also crucial. Modern temperature and humidity control systems are also key, as they allow you to create healthy and safe architecture for various animal species. Sometimes in climatic and environmental conditions that are extremely different from those natural to their habitats. These factors, together with research in the field of zoology, have greatly changed the fate of animals living in zoos and the architecture of the spaces intended for them.[13]

4. CONTEMPORARY FORMS OF BUILDINGS FOR ANIMALS IN THE ZOO

All the solutions mentioned above obviously influence the form of architectural structures erected to meet the needs of animals (and the growing crowds of visitors) in zoos today. Both historicizing and purely functionalist forms remain on the defensive. Authors of the designs and clients try to make new buildings and structures attractive, drawing attention with their unusual form, exposure or innovative functional layout.

One of the most famous and widely discussed buildings in the literature[14] is the Elephant House at the Copenhagen Zoo, designed by Sir Norman Foster's office and opened in 2008. The project was based on zoological research, including research on the social life of elephants. Large internal rooms where these animals must stay for many days a year are covered with huge, oval glazing. The unity of architecture and technology enabled the construction of the building and set new standards in the design of this type of buildings. Slightly later projects of elephant houses in Polish zoos – in Poznań and Warsaw – were based on the same guidelines.

Many dynamic aviaries for birds have been created in zoos around the world. The architectural and technological prototypes were undoubtedly the structures designed by Frei Otto in the German pavilion at the Expo in 1967, repeated in a modified form at the Olympic stadium in Munich a few years later[15]. The variety of materials and forms allowed the adaptation of similar structures for both open aviaries and closed, glass pavilions (e.g., zoos in Prague, Vienna or Kraków). Against this background, the parrot cages at the Barcelona Zoo, designed by the Batlleroig studio and put into use in 2009, seem interesting.[16] A number of

[12] A. Bojęś, *Aspekty architektoniczne kształtowania budynków użyteczności publicznej z lekkimi ścianami osłonowymi nowej generacji,* Wydawnictwo Politechniki Krakowskiej, Kraków 2000; T. Krotowski, *Ewolucja ściany osłonowej na przykładzie pawilonów wystaw światowych expo 1851–2012*, PhD thesis, Politechnika Łódzka, Łódź 2016.

[13] M. Drożdż-Szczybura, *Buildings in cities for non-livestock animals*, "PUA – Przestrzeń Urbanistyka Architektura" 2022, no. 1, pp. 5–18. DOI: 10.37705/pua/1/2022/02 (access: 10.11.2024).

[14] See e.g.: M. Atzori, *A Research for a New Space*, "C3" 2010, no. 305, pp. 170–217; J. Gellner, M. Boczar, *op. cit.*

[15] Frei Otto [in:] The Pritzker Architecture Prize, https://www.pritzkerprize.com/laureates/frei-otto (access: 6.05.2024).

[16] Cages for Macaws / Batlleiroig [in:] ArchDaily, 19.11.2009, https://www.archdaily.com/41287/cages-for-macaws-enric-batlle-joan-roig-architects (access: 22.02.2023).

small buildings made of steel and wood, scattered in a grove of palm trees growing in the Barcelona Zoo, refer to the archetype of a birdcage that has appeared in art and popular culture for many centuries. Nevertheless, they have been deconstructed, as if 'drawn out' by the tops, partially built with wood in various shades, and the modern materials used clearly indicate the time of their creation. The buildings themselves create an attractive conglomeration of quasi-sculptural forms in green, and the collision with colourful parrot feathers enhances the visual effect.

Since Poland joined the European Union in 2004, and even during the preparations for this historic process, it has become possible to co-finance numerous construction and infrastructure projects from EU funds. Probably all public zoos existing in Poland at that time, and over time also some small private institutions, benefited from this.[17] In all municipal (public) zoos, over the last quarter of a century, new buildings and enclosures for animals have been built to meet modern breeding and exhibition requirements, most of them probably in the zoo in Opole,[18] destroyed by the flood in 1997, but also in the intensively expanded zoos in Zamość and Kraków, and above all in Łódź and Wrocław. In many institutions, development works, including renovation and adaptation works, are still continued (e.g., Wrocław, Kraków).[19]

Among many projects in the Kraków Zoo, there is a complex of two pavilions and enclosures for big cats,[20] the first of which was put into use in 2008, and the second almost a decade later. The buildings are located in the southwestern part of the garden, in a dense, high forest.[21] Monumental, tubular arches finished with stainless steel provide a delicate mesh that covers the catwalks (three in the first building and two in the next one), with the background being a single-story, reinforced concrete pavilion wall finished with stone. After a dozen or so years, the building, partially immersed in the greenery growing around and on the catwalks, looks perfect. Observation of lions, tigers, panthers and jaguars is also

[17] In 2023, there were 28 zoos in Poland, 18 of which were founded in 1865–1978 (including the Gdynia Aquarium and the Exotarium in Sosnowiec) as state or municipal institutions. The rest were created after 2000 – mostly as private initiatives. 11 of them are affiliated with EAZA (zoos in: Poznań, Wrocław, Opole, Chorzów, Kraków, Zamość, Warsaw, Łódź, Płock, Toruń and Gdańsk), and 6 with WAZA (zoological gardens in Opole, Wrocław, Kraków, Warsaw , Łódź, Gdańsk), which guarantees their participation in the latest research, breeding and reintroduction programs of species. They must also meet strict modern standards in terms of enclosures and rooms for animals, as well as methods of their exhibition.

[18] M. Adamska, *op. cit.*

[19] The author's in situ research from 1997–2024, publications on the websites of zoos, architectural offices and online groups: Fans of Zoo – https://www.facebook.com/groups/1703738966399846 and Modern Zoo Design – https://www.facebook.com/groups/1710116545968098 (access: 01.2022–06.2024). Currently, finishing works are underway at the Krakow Zoo on a new aviary and a pavilion for chimpanzees and Japanese macaques, designed by the Minima office, the authors of the reconstruction of the pavilion for pygmy hippos, completed in 2023 – https://minima.com.pl/ (access: 1.05.2024). In turn, in the oldest zoo in Poland, Wrocław, the Creoprojekt studio is modernizing the historic pavilions – the Aviary received the title of 'Well-Maintained Monument' in 2022 – http://www.creoproject.pl/ (access: 16.11.2023).

[20] Authored by the B2 STUDIO office, who also designed for the same zoo the adaptation of the monkey house pavilion (2005), the giraffe pavilion and enclosure (2013) and the adaptation of the badger enclosure into a penguin enclosure and pavilion (2016 Modernization of the Year award) https://b2studio.com.pl/ (access: 6.05.2024).

[21] The zoo in Krakow is located in the Wolski Forest, the closest green enclave to the city centre, located on the Sowiniec hills separating the Vistula valley from the Rudawa valley.

possible through large armoured glass located in oversized portals made of raw, smoothed reinforced concrete.

In accordance with the principles of 'shock' and 'following the novelty', which is an immanent feature of modern civilization and culture,[22] functional complexity and combining various animal species in joint exhibitions, or exhibiting various biotopes in huge buildings, is the latest trend in zoos.[23] Such hybrids combine various technological systems and various exhibitions and are being designed more and more often. In Poland, there are two pavilions so far: the Afrykarium in the Wrocław Zoo, opened in 2014, and the Orientarium in the Łódź Zoo, which opened to the public in 2022, nearly a decade later. The Afrykarium is a building presenting various features typical of Africa and the surrounding it ocean biotopes, while the much larger Orientarium, based on the experiences of the abovementioned Afrykarium, is devoted to the fauna and flora of Southeast Asia and the Indian Ocean.

Both buildings combine features and exhibitions typical of oceanariums, internal pavilions for thermophilic birds, mammals, amphibians, reptiles and fish, and outdoor enclosures. They were created as a result of architectural competitions won by the architectural offices run by Dorota Szlachcic from Wrocław.[24] Despite the enormous technological and structural complexity, the architects managed to create characteristic, strong forms that also function perfectly as year-round buildings in which numerous animal species exist and breed, which proves that they are provided with good living conditions, despite crowds of visitors. The offspring of endangered species exhibited in the Afrykarium, such as fur seals, penguins and, above all, Caribbean manatees, are particular proof that in this hybrid architectural building it was possible to create an appropriate environment, both thanks to the design of the space (architecture) and the control of physico-chemical features (engineering).[25]

The architectural form of the Wrocław building is quite compact and monumental. It consists of two volumes: a black cuboid with dimensions of approx. 160x54x15m[26], housing five main exhibition zones (including an oceanarium with an underwater acrylic tunnel for visitors) and a dynamic boat-shaped structure that pierces it from the south, partially finished with Corten steel. This additional structure separates the external enclosures of the cats and penguins, enabling their observation both underwater, through acrylic glass, and above the surface from piers running along the façade. There are also aquariums with fish, corals, jellyfish and other marine organisms inside. A characteristic element of the

[22] What Tom Dyckhoff writes about: T. Dyckhoff, *Epoka spektaklu. Perypetie architektury i miasta XXI wieku,* Karakter, Kraków 2018

[23] Hybrids in architecture were initially defined already in the late 1980's, in Polish science, this research has been developed by M. Gyurkovich since the beginning of the 21st century.

[24] Authors of Afrykarium in Wrocław Zoo: Dorota & Mariusz Szlachcic with ArC2 Fabryka Projektowa – https://arc2.com.pl/ (access: 16.02.2024). Authors of Orientarium in Łódź Zoo: Szlachcic Architekci – https://szlachcicarchitekci.pl/ (access: 11.03.2024)

[25] ZOO Wrocław – https://zoo.wroclaw.pl/ (access: 6.05.2015–10.06.2024).

[26] The volume of the building is over 184,000 m^3, the volume of water in the exhibition tanks (both freshwater and saltwater) is 13,000 m^3 (of which approx. 6,000 m^3 in two external penguin and catfish pools) and at the same time 5,000 m^3 in the filtration installations. The usable area of the pavilion is nearly 9,000 m^2, the service area is approximately 7,000 m^2, and the external exhibitions cover an area of nearly 7,500 m^2 – from: https://zoo.wroclaw.pl/afrykarium/afrykarium-w-liczbach/ (access: 5.06.2024).

building is its front elevation, with a monumental arcade leading to the main entrance. The monolithic nature of the black building (the finish is mineral-acrylic facade boards) is also broken by rounded corners, making the building similar to a naturally created fold. In the arcade, there are black and red panels with drawings of various animal species referring to African art, which is intended to be a preview and introduction to the exhibition. This part of the building is visible from the entrance to the Wrocław Zoo, located opposite the Centennial Hall, to which, according to the pavilion's designers, it is a contemporary response.[27]

The individual climate zones of the Afrykarium intended for semi-desert, savannah and jungle animals, swamps and mangroves are separated by appropriate thermal partitions, and the visitor's path passes through numerous locks in moments of 'climate change'. They also prevent individual species (mainly birds and butterflies) from migrating from free flight zones to other exhibition zones. The building also has an exhibition devoted to nocturnal animals. The structure of the building is also hybrid, made of concrete, steel, glued wood and acrylic coatings, which allowed the creation of spacious volumes for individual groups of species and visitor services.

The design of the Orientarium in Łódź, almost a decade later, undoubtedly used improved technological and construction solutions, tested by the creators earlier in Wrocław. Its functional programme is even more complicated, as it includes, apart from zones similar to those in Wrocław, also fragments of the exhibition dedicated to Asian elephants, bears, Malayan tapirs, Anoa cattle and orangutans, which, due to their size, require very large spaces.[28] The building, together with extensive, adjacent enclosures and aviaries, occupies almost half of the area of the Łódź Zoo.[29]

The Łódź Zoo is located in a large recreational greenery complex in the western part of the city. The hybrid Orientarium building seems to meander among the old trees. Its facades are very long, but thanks to the faults and fragmentation of the body, unnecessary monumentalism was avoided. The treetops, which rise to a height more than twice as high as the building, shade and partially hide the massive structure. Unlike the Wrocław pavilion, in the Łódź building, the architects focused on gaps and openwork elements wherever possible for functional reasons. The use of façade cladding imitating irregular, narrow planking or green roofs on part of the building additionally makes it seem to blend in with the surrounding forest (especially in the summer months). The interior design elements are still visible, including wooden lattice suspended ceilings with a characteristic pattern, which have now, after many years, been partially covered by the greenery growing inside. In parts of the interior, in addition to natural landscape elements, stylized ruins of Buddhist temples or the wreck of a Japanese military plane from World War II have been recreated.

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[27] D. Hajok, *Czarny jak Afryka*, "Budownictwo, Technologie, Architektura" 2015, no. 1, pp. 26–27.

[28] The indoor enclosure for elephants is currently the largest in Europe – 2,000 m^2 and a swimming pool with an acrylic glass through which visitors can observe the bathing of four Indian elephants living there – https://orientarium.lodz.pl/ (access: 4.06.2024).

[29] The Orientarium building itself has 33,000 m^2 of usable space. The building was recognized by the International Property Awards as the best architectural project in the world in two categories: Leisure Architecture and Public Service Architecture 2022–2023. At the IPAX gala in London, the project received the Best International Leisure Architecture and Best International Public Service Architecture 2022–2023 awards – https://archinea.pl/architektura-biotopow-orientarium-w-lodzi-najlepszy-budynek-minionego-roku-w-polsce/ (access: 3.06.2024).

Thanks to this, a visit to the building is much more conducive to popular tastes than to the Afrykarium, especially young viewers accustomed to changing attractions, like in video games. The colours of beige and grey, used outside against a dark background, and large glazing create a different visual perception and character of the Orientarium. Formal solutions – dark walls and a spacious entrance arcade with stylized images of animals (this time black silhouettes on a white background) indicate similarities between the buildings.

5. CONCLUSIONS

The author's in situ research and literature studies have proven that the search for new forms and structures in the 21st century applies not only to urban public buildings from the front pages of magazines, such as opera houses, museums, theatres and skyscrapers. But also buildings and spatial structures of various scales intended for animals (and visitors) in zoos. Their authors include both the most famous names of star architects (such as Sir Norman Foster), as well as specialized studios that have completed an increasing number of such projects (such as Polish design companies: ArC2 Fabryka Projektowa, B2 Studio or Minima). Complex technologies related to the breeding and exhibition of exotic animal species, along with safety requirements for visitors, have a huge impact on the final architectural form. It seems that buildings and structures for animals built in zoos are one of the best examples of the coexistence of architecture, understood as the art of shaping space, and technology that makes this space functional and safe for all its users.

Ill. 1. Covering in the rainforest pavilion – Tiergarten Schönbrunn, Vienna, photo: M. Gyurkovich.

Ill. 2. Interior of the Arctic and Antarctic pavilion – Tiergarten Schönbrunn, Vienna, photo: M. Gyurkovich.

Ill. 3. The interior of the hippopotamus pavilion – zoo in Krakow, photo: M. Gyurkovich.

Ill. 4. Big cat pavilions – zoo in Krakow, photo: M. Gyurkovich.

Ill. 5. Africarium in Wrocław, photo: K. Dudzic-Gyurkovich.

Ill. 6. Africarium, acrylic tunnel in the oceanarium zone, photo: K. Dudzic-Gyurkovich.

Ill. 7. Orientarium in Łódź, Elephant House, photo: T. Grzelakowski.

Ill. 8. Orientarium in Łódź, photo: T. Grzelakowski.

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[2] Afrykarium w liczbach [in:] ZOO Wrocław https://zoo.wroclaw.pl/afrykarium/afrykarium-w-liczbach/ (access: 5.06.2024).

[3] *Architektura biotopów. Orientarium w Łodzi – najlepszy budynek minionego roku w Polsce* [in:] Archinea, 5.06.2023, https://archinea.pl/architektura-biotopow-orientarium-w-lodzi-najlepszy-budynek-minionego-roku-w-polsce/ (access: 3.06.2024).

[4] ArC2 Fabryka Projektowa, https://arc2.com.pl/ (access: 16.02.2024).

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[13] Fans of Zoo, https://www.facebook.com/groups/1703738966399846 (access: 01.2022–06.2024).

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