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THE DOME: SHAPING THE ARCHITECTURE OF MODERN ACADEMIC LIBRARIES

KOPUŁA KSZTAŁTUJĄCA ARCHITEKTURĘ WSPÓŁCZESNYCH BIBLIOTEK AKADEMICKICH

Abstract

Reading rooms of major historic academic libraries have been covered by domes. The impressive scale of the domes, combined with rows of tables, chairs, and bookshelves, created an atmosphere that encouraged study and reading. Notable examples include the Radcliffe Camera by J. Gibbs (Oxford, 1749) and the Rotunda of the University of Virginia by T. Jefferson (1826). Since the 1990s, technological and social changes have transformed library architecture. Modern libraries no longer symbolize exclusivity and power but emphasize transparency and accessibility. This article explores contemporary domes in academic libraries, highlighting their advanced construction and significant impact on the building's appearance, atmosphere, and functionality. Examples include designs by Santiago Calatrava in Zurich (2004), Helmut Jahn in Chicago (2011), and Jean Nouvel in Nicosia (2018).

Keywords: academic libraries, library architecture, domes, contemporary architecture, architectural engineering

Streszczenie

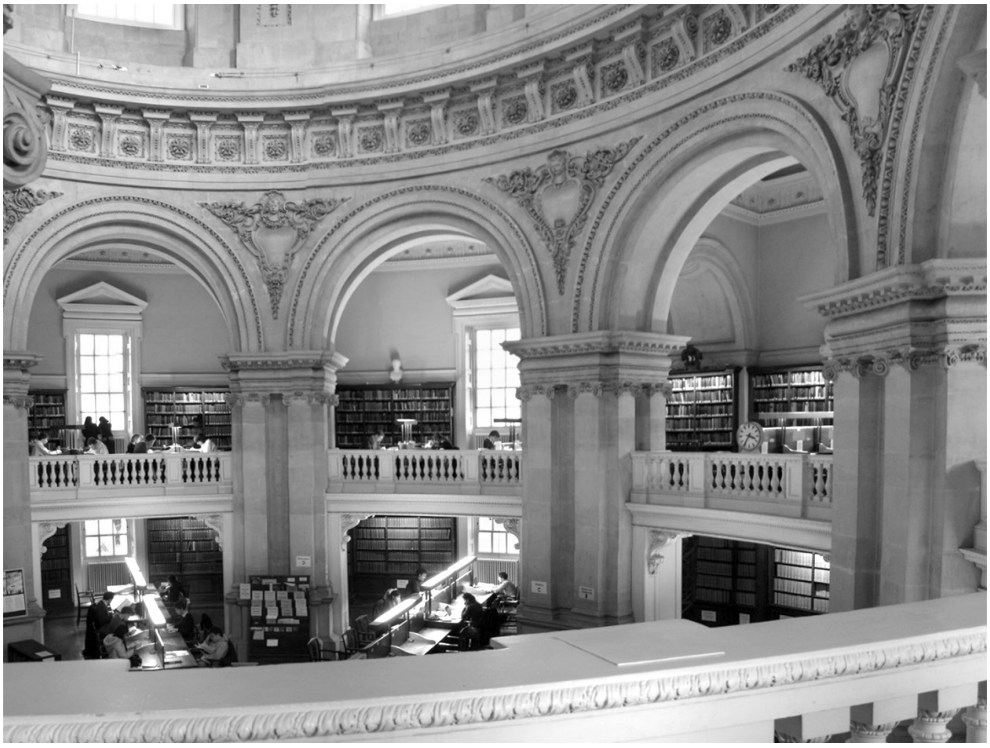
Czytelnie wielkich i ważnych bibliotek akademickich w historii przekryte były kopułami. Skala sklepienia w połączeniu z rzędami stołów, krzeseł i regałów z książkami nadawała wnętrzu wyjątkowy charakter, zachęcając do nauki i czytania. Przykładami są Radcliffe Camera, arch. J. Gibbs (Oxford, 1749) lub Rotunda Uniwersytetu w Virginii, arch. T. Jefferson (1826). Od lat 90. XX w. zmiany technologiczne i społeczne zmieniają formę budynku biblioteki. Przestała symbolizować wyjątkowość i władzę, a wyraz formalny nowych obiektów podkreślał transparentny i dostępny charakter instytucji. Artykuł ukazuje współczesne rozwiązania formalne i konstrukcyjne kopuł bibliotek akademickich, których struktura i wysoki poziom technicznego zawansowania kształtują wygląd, atmosferę oraz układ funkcjonalny budynku. Opisane przykłady zaprojektowali w Zurychu Santiago Calatrava (2004), w Chicago Helmut Jahn (2011) i w Nikozji Jean Nouvel (2018).

Słowa kluczowe: biblioteki akademickie, architektura bibliotek, kopuły, architektura współczesna, inżynieria architektoniczna

1. INTRODUCTION

Academic libraries with domes emerged in the 17th and 18th centuries. The falling prices of increasingly popular printed books allowed for expanding collections. This shift influenced library interiors, where collections became both furnishings and decorations. The Herzog

August Library in Wolfenbüttel, built in 1710 and demolished in 1886 is considered the first round domed library, although Sir Christopher Wren (1632–1723) designed an unrealized central-plan domed library for Trinity College in 1675. Wren's round reading room featured skylights and lanterns, with walls adorned by decorative book spines. Librarians accessed books via a hidden gallery.[1] Wren's design inspired Nicholas Hawksmoor (1661–1736) in the Radcliffe Camera library project in Oxford, funded by John Radcliffe (1650–1714) and completed by James Gibbs (1682–1754) in 1748. This neoclassical building has a dome on a drum with pilasters and windows. The interior includes a ground floor and a tall cylindrical reading room with books along the walls. Originally, the dome was to be stone, but plans showed a truss between two shells. Limited book storage suggests it serves mainly as a monument to the founder. Since 1863, it has been part of the Bodleian Library.[2] Domed academic libraries emphasized the institution's importance and role. Monumental, historicizing domes and structures signify a library type associated with significant institutions or authorities, exemplified by Jefferson's Rotunda at the University of Virginia, the U.S. Capitol Library, the Round Reading Room of the British Museum, and the Stockholm Public Library.



Ill. 1. Radcliffe Camera, view from the gallery, by Stickinho, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=8565815 (access: 26.06.2024).

[1] J.W.P. Campbell, W. Pryce, *The library: A world history*, Thames & Hudson, London 2020, pp. 142–147.

[2] M. Eisen, *Zur architektonischen Typologie von Bibliotheken* [in:] Winfried Nerdinger (ed.), *Die Weisheit baut sich ein Haus. Architektur und Geschichte von Bibliotheken*, Prestel, München 2011, p. 285.

Contemporary academic library buildings differ from historical examples not in size or collection volume, but in form and function. Since the 1990s, technological advancements in knowledge collection and distribution have again altered their design. Increasingly, they incorporate features previously found elsewhere on campus, such as conference and seminar rooms, cafés, computer labs, and art galleries. Many universities have transformed the character of their libraries through modern architecture.[3] Simultaneously, domes in contemporary academic libraries are adapted to modern challenges and technical possibilities. This article outlines current design trends for domes in academic libraries, which, as in history, cover spacious reading rooms. This illustrates changes in the architectural form and expression of the dome, moving away from its historical symbol of power through modern construction techniques and materials to create inviting spaces for readers and books. Based on literature reviews and in-situ research (examples from the USA and Cyprus), the topic is illustrated with three examples:

- University of Zurich Law Library, 2004, designed by Santiago Calatrava;
- Joe and Rika Mansueto Library in Chicago, 2011, designed by Helmut Jahn;
- Stelios Ioannou Learning Resource Center in Nicosia, 2018, designed by Jean Nouvel.

These buildings were selected for their domes, material availability, and the architects' renown.

2. UNIVERSITY OF ZURICH LAW LIBRARY, 2004, DESIGNED BY SANTIAGO CALATRAVA

To accommodate the University of Zurich's Law Faculty, which was scattered across several buildings, Santiago Calatrava designed an expansion of the 1908 building. The renovation lasted from 2000 to 2006 (the building opened in 2004), adding two floors and increasing the floor area by 4,796 m² to 25,245 m². The historical structure was renovated and adapted to modern needs.[4] The central feature of the design is the faculty library, positioned within the courtyard walls as a steel structure vaulted with a glass-steel dome spanning 30 meters. Entering the library from the ground floor, one does not immediately see readers or books; instead, the eye is drawn from the white floor upwards along the warm-toned wooden oval galleries. The interior, illuminated by natural light, exudes silence and a focused atmosphere. Glass elevators with a circular plan are installed at the courtyard's corners. As one ascends in these elevators, it becomes apparent that the reading room is a suspended structure within the courtyard, housing both readers and books,[5] as S. Calatrava mentions: "The fact that the library is suspended in the courtyard gives it what I would call a levitating character. Books are material and heavy, whereas knowledge is immaterial, almost weightless – this is what

[3] J.W.P. Campbell, W. Pryce, *op. cit*.

[4] R. Strehler, S. Hein, *Universität Zürich, Rechtswissenschaftliche Fakultät, Rämistrasse 74, Hofeinbau und Aufstockung. Objektdokumentation*, Baudirektion Kanton Zürich, Zürich 2013, https://www.zh.ch/content/dam/zhweb/bilder-dokumente/themen/planen-bauen/hochbau/bauprojekte/hochschulbauten/universitaet-zuerich/uzh-r%C3%A4mistrasse-74/2013_objektdoku_uzh_rechtswissenschaftliche_fakultaet.pdf (access: 22.06.2024).

[5] W. O'Connor, *The world's most hated architect created one hell of a library* [in:] The Daily Beast, 24.10.2021, https://www.thedailybeast.com/santiago-calatrava-may-be-the-worlds-most-hated-architect-but-he-created-one-hell-of-a-library (access: 22.06.2024).

I wanted to highlight […] The library thus floats in the courtyard, as if it were a huge piece of furniture".[6]

Ill. 2. University of Zurich Law Library by Santiago Calatrava, source: thost, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=3601336 (access: 26.06.2024).

[6] S. Calatrava, *Wissen ist schwerelos – das wollte ich sichtbar machen*, interview by Simone Buchmann [in:] Universität Zürich, 21.11.2004, http://www.news.uzh.ch/de/articles/2004/1363.html (access: 22.06.2024).

The layout of the library resembles an ellipse or the outline of a human eye. The six-floor galleries form a pathway around the courtyard. They house individual workstations, bookshelves, computer stations, and access to meeting rooms or copier facilities. Offices and additional individual and group workspaces are located on the two floors of the annex. The lower level contains large rooms and a book storage area, while the upper-level features workrooms for doctoral students. The library provides 5,000 linear meters of shelves and 500 workspaces.[7]

The support system of the oval dome consists of three steel arches running along the courtyard's axis. These are stabilized by steel ribs, which support the glazing. Internal blinds on the dome can serve as sunshades. Roof openings aid the building's natural ventilation and, depending on conditions, allow for natural cooling at night. The communication cores act as supports for the steel structure. The construction of the added floors includes steel columns and composite reinforced concrete slabs. The roof structure is made of steel trusses, which hold the copper roofing on a substructure.[8]

The library designed by Calatrava is not visible from the outside; it is only when exploring the building that one can discover the author's concept: "Personally, I see it as a building that rests within itself. It is not a showy work that demands attention. It was very important to me to leave something beautiful and functional for the students. I put myself in their place and focused on their needs. When inside, one can be truly captivated".[9]

The building won the ECCS European Steel Design Award 2003.

3. JOE AND RIKA MANSUETO LIBRARY, 2011, DESIGNED BY HELMUT JAHN

The Joe and Rika Mansueto Library features an elongated glass dome located on the University of Chicago campus. It is an expansion of the Joseph Regenstein Library, built in 1970 by architect Walter Netsch of Skidmore, Owings and Merrill. The original library is a large brutalist building with a sculpted facade, housing reading rooms, workspaces, and a collection of 4.5 million volumes across five above-ground and two underground floors. In 2005, the decision was made to expand the library to increase storage space for books. The university aimed to accommodate 3.5 million volumes without significantly altering the campus structure. Helmut Jahn, the project's architect, designed an underground automated book storage system topped by a reading room for 180 people under the dome. The dome measures 35.5 meters in width, 73 meters in length, and 10.6 meters in height at its highest point.[10]

Entrance to the dome is through a glass corridor connecting the old library building with the new one. According to Jahn: "the best buildings are always the ones which derive their aesthetic, their appearance from what they house. I found actually it was a very good thing that we entered the building from the existing building and not from the outside".[11] The interior of the dome offers a calm, well-lit, and welcoming environment for working with

[7] R. Strehler, S. Hein, *op. cit*., p. 14.
[8] *Ibidem*, pp. 26–27.
[9] S. Calatrava, *Wissen ist…*, *op. cit*.
[10] Mansueto by the Numbers [in:] The University of Chicago Library, https://www.lib.uchicago.edu/mansueto/tech/numbers/ (access: 1.03.2022).
[11] H. Jahn, *UChicago Architecture: Helmut Jahn on the Ethos of Mansueto Library*, 10.062014, https://www.youtube.com/watch?v=Y8bn75sFBso (access: 22.06.2024); in-situ research, May 2022.

books. To ensure proper lighting conditions, light sources were integrated with the furniture and fixtures. Students have positively rated the library for its conducive research and reading environment, noting the favorable acoustics and manageable sunlight on computer screens. For students, the reading room under the glass dome feels "like being outside without stepping on wet grass."[12] The building has become an icon of the university, with its futuristic appearance serving as a set for the science fiction film "Divergent" in 2013 and the TV series "Dark Matter" in 2024.

Ill. 3. Joe and Rika Mansueto Library by Helmut Jahn, May 2022, photo by author.

The main structural support of the dome is a lattice shell made of 168 mm diameter tubes. For a uniform appearance, the diameter was kept constant while the wall thickness varied based on the load. The nodes of the structure were prefabricated in Germany and assembled on-site into tube segments using bolts. The supporting forces of the dome are transferred by a concrete ring 1.5 meters wide. The glazing is placed on a substructure attached to the main structure at node points using 150 mm high stainless-steel elements. The substructure consists of 60 mm × 60 mm aluminum profiles that linearly support the glass panels. Each glass pane is secured by eight aluminum clamp holders. The dome's design allows for covering with flat glass panes; the upper panels are rectangular, and those at the base are rhomboidal. To ensure proper lighting, heating, and transparency, a raster of dots is printed on the glass: white facing to the inside and black to the outside.[13]

[12] K. Blair, *For books, new life in a bubble* [in:] Chicago Tribune, 18.05.2011, https://www.chicagotribune.com/entertainment/ct-xpm-2011-05-18-ct-live-0518-library-kamin-20110518-story.html (access: 22.06.2024).

[13] W. Sobek, L. Blandini, A. Krtscha, *Die Sondertragwerke der "Mansueto Library" in Chicago – vom Entwurf zum Bau*, "Stahlbau" 2011, no. 80(S1). DOI: 10.1002/stab.201120001.

The underground concrete storage facility, 15.24 meters deep, is fully automated. Books are stored in 24,000 bins on shelves, each marked with barcodes. When a user places a request, one of five cranes retrieves the appropriate bin and delivers it to a staff member, who selects the desired book. The entire process takes up to five minutes. The automated underground storage occupies only 1/7th of the space required by conventional storage methods and allows for energy-efficient maintenance of an optimal temperature of 15.5°C.[14]

4. STELIOS IOANNOU LEARNING RESOURCE CENTER IN NICOSIA, 2018, DESIGNED BY JEAN NOUVEL

The silhouette of the library building and its green-blue facade are inspired by the landscape of the plateau in Cyprus. The slopes of the "earth-work"[15] are covered with a perforated membrane, over which a white dome towers. The PVC membrane, covering an area of 5,500 m², is stretched over a steel structure attached to the reinforced concrete supporting structure. This creates the form of a "hill" and serves as a sunshade, providing a shaded path to the building. Airflow and sunlight can be regulated with adjustable panels. The PVC mesh ensures a uniform facade effect, with invisible membrane joints. The membrane's lifespan is estimated to be between 21 and 30 years.[16] The building has an area of 15,700 m², with five floors (including two underground), and accommodates 900 workspaces. It houses a library, an information systems department, a teaching technology center, and a language center. The collection includes approximately 700,000 volumes, 538,000 e-books, 12,000 journal subscriptions, and access to 188 databases.[17]

The irregular layout of the building consists of main parts: the library and reading room in the form of a circle surrounded by a foyer, and three wings housing auxiliary rooms, training facilities, offices, and conference rooms.[18] The central part is the library, organized within a 40-meter-high cylinder with a centrally positioned atrium that spans the entire height of the space. This creates an open space with workstations and bookshelves on each floor surrounding the atrium. On the top floor, under the dome, workstations are arranged along the cylinder's edge, offering views of the surroundings. The library is covered by a transparent dome spanning 50 meters, made of steel elements prefabricated by the manufacturer and transported to the construction site. The budget for the dome was one million euros.[19] It has rotating blinds to regulate natural light income, directing it to the atrium center where a heliostat reflects it to the lower levels. The heliostat is a 24-meter-high white cone with a 5-meter base radius, ensuring natural light reaches all reading area.[20] Complementing the workspaces

[14] L. Jones, *Library space and print* [in:] G. Matthews, W. Graham (eds.), *University libraries and space in the digital world*, Routledge, London 2016, p. 75.

[15] O. Boissière, *Stelios Ioannou Learning Resource Center (LRC)* [in:] Ateliers Jean Nouvel, https://www.jeannouvel.com/en/projects/learning-resource-center/ (access: 23.06.2024).

[16] *Anthropic Hill – Stelios Ioannou Learning Resource Center Nicosia* [in:] Tensinet, https://www.tensinet.com/index.php/projects-database/projects?view=project&id=4693 (access: 23.06.2024).

[17] *Ibidem*; O. Boissière, *op. cit.*; [G. Kelveris], *"Stelios Ioannou" Learning Resource Centre* [in:] University of Cyprus Library, https://library.ucy.ac.cy/information/stelios-ioannou-lrc/?lang=en (access: 23.06.2024).

[18] In-situ research by author in December 2023.

[19] *Jean Nouvel & the Dome…*, *op. cit*.

[20] [G. Kelveris], *op. cit*.

in the large open-space reading area are 31 group workrooms. These rooms are “suspended” in the foyer along the outer perimeter of the cylinder. Their walls of red tempered glass stand out against the backdrop of the raw concrete walls.[21]

Ill. 4. Stelios Ioannou Learning Resource Center in Nicosia, 2018, arch. Jean Nouvel, December 2023, photo by author.

Ill. 5. Heliostat in the reading room, ground floor, December 2023, photo by author.

[21] *Ibidem*; *University of Nicosia – The Library, Nicosia, Cyprus* [in:] Vanceva Color Studio, https://www.vanceva.com/gallery/university-nicosia-library-nicosia-cyprus (access: 23.06.2024).

This is the first library of its kind in Cyprus, designed not only to store books but also to provide digital tools for utilizing knowledge. The investment cost 35 million EUR, with 20 million EUR funded by the European Regional Development Fund under the Operational Program "Competitiveness and Sustainable Development." The construction was also financed by a donation from Ellie Ioannou and is named after her husband. In accordance with the donor's wish, the building was designed by French architect Jean Nouvel.[22]

5. SUMMARY

An academic library can either be housed in a separate campus building or be a designated area within the university dedicated to collecting and sharing knowledge. Only a few libraries are designed with spaces that are also meant to be admired. Historically, in such buildings, architecture, furnishings, and the primary "content" – books and readers – create a unique atmosphere that goes beyond the purely practical aspects of a library.[23] Academic libraries that have become famous and/or "iconic" serve as distinctive landmarks on campus and as meeting places for the university's academic community. In such buildings, domes highlighted the role and program within the city and campus structure, often housing spacious reading rooms underneath. Departing from architectural traditions has altered the expression of academic library architecture, leading to a loss of their formal identity.[24] The way they are designed has evolved not only with changes in the methods of storing book collections but also with new construction techniques and material possibilities.

In the examples provided, the domes stand out from the library structures as independent formal elements, defining the reading spaces and their atmosphere. Just as in history, they continue to create significant meeting places for the academic community. These contemporary domes are complex structures and constructions that impact the building's functionality – they are linked to interior lighting, ventilation, microclimate, and the building's energy needs. Achieving the architect's envisioned appearance and character often requires international coordination and collaboration with various specialists, particularly structural engineers and experts in glass production, energy consumption, and air conditioning. The examples illustrate diverse buildings with distinctive architecture, creating reader- and book-friendly spaces. It is noteworthy that through technology and techniques, the form of the dome still expresses the importance of the library and its program. This is also evident in the words of Helmut Jahn, who describes the Chicago project:

> It's not a big building, but it's an important building. It's very refined. This is a place where science, physics, the liberal arts are taught […]. In science and physics, you never get to the end because there is no end and I believe in architecture it's the same way and so this building stands for belief of the leading forces in this institution […]. Team work is very important in architecture. In making the building work the most important was the structural

[22] *University of Cyprus' new library benefits everyone* [in:] Inforegio, 18.06.2020, https://ec.europa.eu/regional_policy/en/projects/Cyprus/university-of-cyprus-new-library-benefits-everyone (access: 23.06.2024).
[23] J.W.P. Campbell, W. Pryce, *op. cit*., pp. 19–20.
[24] *Ibidem*.

engineer […]. This building isn't the result of an aesthetic concept but is really the result of applying a lot of knowledge, a lot of experience. Not only what you know from the past but also pushing the boundaries and in exploring new things, looking in the future. Like any good building it's the context, it's the program, it's how you plan it and how you construct it, and how the appearance of the building is the result of all these efforts. So, it's very technical, it becomes then a piece of art if you're successful.[25]

References

[1] *Anthropic Hill – Stelios Ioannou Learning Resource Center Nicosia* [in:] Tensinet, https://www.tensinet.com/index.php/projects-database/projects?view=project&id=4693 (access: 23.06.2024).

[2] Blair K., *For books, new life in a bubble* [in:] Chicago Tribune, 18.05.2011, https://www.chicagotribune.com/entertainment/ct-xpm-2011-05-18-ct-live-0518-library-kamin-20110518-story.html (access: 22.06.2024).

[3] Boissière O., *Stelios Ioannou Learning Resource Center (LRC)* [in:] Ateliers Jean Nouvel, https://www.jeannouvel.com/en/projects/learning-resource-center/ (access: 23.06.2024).

[4] Calatrava S., *Wissen ist schwerelos – das wollte ich sichtbar machen*, interview by Simone Buchmann [in:] Universität Zürich, 21.11.2004, http://www.news.uzh.ch/de/articles/2004/1363.html (access: 22.06.2024).

[5] Campbell J.W.P., Pryce W., *The library: A world history*, Thames & Hudson, London 2020.

[6] Eisen M., *Zur architektonischen Typologie von Bibliotheken* [in:] Winfried Nerdinger (ed.), *Die Weisheit baut sich ein Haus. Architektur und Geschichte von Bibliotheken*, Prestel, München 2011, pp. 261–306.

[7] Jahn H., *UChicago Architecture: Helmut Jahn on the Ethos of Mansueto Library*, 10.06.2014, https://www.youtube.com/watch?v=Y8bn75sFBso (access: 22.06.2024).

[8] *Jean Nouvel & the Dome of the University of Nicosia* [in:] Anro, 1.12.2022, https://anro.es/jean-nouvel-the-dome-of-the-university-of-nicosia/ (access: 23.06.2024).

[9] Jones L., *Library space and print* [in:] G. Matthews, W. Graham (eds.), *University libraries and space in the digital world*, Routledge, London 2016, pp. 71–84.

[10] [Kelveris G.], *"Stelios Ioannou" Learning Resource Centre* [in:] University of Cyprus Library, https://library.ucy.ac.cy/information/stelios-ioannou-lrc/?lang=en (access: 23.06.2024).

[11] Mansueto by the Numbers [in:] The University of Chicago Library, https://www.lib.uchicago.edu/mansueto/tech/numbers/ (access: 1.03.2022).

[12] O'Connor W., *The world's most hated architect created one hell of a library* [in:] The Daily Beast, 24.10.2021, https://www.thedailybeast.com/santiago-calatrava-may-be-the-worlds-most-hated-architect-but-he-created-one-hell-of-a-library (access: 22.06.2024).

[13] Sobek W., Blandini L., Krtscha A., *Die Sondertragwerke der "Mansueto Library" in Chicago – vom Entwurf zum Bau*, "Stahlbau" 2011, no. 80(S1), pp. 3–6. DOI: 10.1002/stab.201120001.

[14] Strehler R., Hein S., *Universität Zürich, Rechtswissenschaftliche Fakultät, Rämistrasse 74, Hofeinbau und Aufstockung. Objektdokumentation*, Baudirektion Kanton Zürich, Zürich 2013, https://www.zh.ch/content/dam/zhweb/bilder-dokumente/themen/planen-bauen/hochbau/bauprojekte/hochschulbauten/universitaet-zuerich/uzh-r%C3%A4mistrasse-74/2013_objektdoku_uzh_rechtswissenschaftliche_fakultaet.pdf (access: 22.06.2024).

[15] *University of Cyprus' new library benefits everyone* [in:] Inforegio, 18.06.2020, https://ec.europa.eu/regional_policy/en/projects/Cyprus/university-of-cyprus-new-library-benefits-everyone (access: 23.06.2024).

[25] H. Jahn, *op. cit*.

[16] *University of Nicosia – The Library, Nicosia, Cyprus* [in:] Vanceva Color Studio, https://www.vanceva.com/gallery/university-nicosia-library-nicosia-cyprus (access: 23.06.2024).

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