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ARCHITECTURAL EXPERIMENTS IN TEMPORARY PAVILIONS

PAWILONY DOŚWIADCZALNE W POSZUKIWANIACH ARCHITEKTONICZNYCH

Abstract

The technological advances of the 21st century amplify the creative exploration and search for futuristic, visionary architecture. Exhibition pavilions are unique testing grounds for observing and analyzing the creative achievements in solving problems of contemporary architecture. Decisions regarding the selection of materials and technologies are becoming crucial to expanding the professional skills of the architect. The relatively short period of operation of such pavilions creates favorable conditions for experimenting with modern possibilities of computational design, which are the determinants of architects' work in the rapidly changing multidisciplinary design environment. Temporary exhibition pavilions encourage architects to experiment with the application of new materials or the use of traditional materials in different technologies. This paper will present examples of contemporary design experiments which evoke vibrant discussions as the objects differ from traditional architecture in many respects.

Keywords: generative algorithms, emergence, topology, pavilions

Streszczenie

Wiek XXI w architekturze to czas poszukiwania wizjonerskich, futurystycznych wizji architektury. Pawilony wystawowe stanowią wyjątkowe poligony doświadczalne do obserwowania i analizowania dokonań twórczych w rozwiązywaniu problemów współczesnej architektury. Decyzje dotyczące doboru materiałów i technologii stają się kluczowe do poszerzania umiejętności zawodowych architekta. Stosunkowo krótki okres funkcjonowania pawilonu to sprzyjający poligon w oswajaniu się z nowoczesnymi możliwościami komputacyjnego projektowania, które są wyznacznikiem pracy architektów, w zmieniającym się środowisku multidyscyplinarnego projektowania. Tymczasowość pawilonów wystawowych skłania architektów do odważnych eksperymentów w zastosowaniu nowych lub wykorzystanie tradycyjnych materiałów w różnych technologiach. W referacie zostaną zaprezentowane przykłady współczesnych eksperymentów projektowych, które wywołują dyskusje, jako odmienne pod wieloma względami obiekty w kontraście do tradycyjnej architektury.

Słowa kluczowe: algorytmy generatywne, emergencja, topologia, obiekty pawilonowe

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1. INTRODUCTION

The architecture of exhibition pavilions is characterized by a wealth of experimentation in the usage of new materials and new design methods, which is particularly evident in the example of the world EXPO exhibition pavilions. In the 21st century, there was a significant increase in the creation of experimental objects that are an emanation of the new way of thinking and sophistication of multi-disciplinary design. Contemporary designs also change the perception of architecture. One of the most important rules written by Vitruvius: *firmitas,* ceases to be perceived in its traditional way. The architects' desire to leave behind a memorable creation, or by building monumental buildings, has significantly changed its meaning in the era of the Internet. Current projects, which at the time of their creation had a significant impact on the shaping of architecture, are recorded mainly in digital media. The EXPO pavilions and small scale pavilions with a reduced function are objects that have a significant impact on the development of architectural thought. The understanding of design phenomena is deepened by the design of small-scale pavilions. Under the rigors of their time of creation, duration of their existence and limited costs of construction, the architects have the opportunity to test the latest materials, methods and fabrication techniques. The search can take place on many levels, and can also be divided into mathematical – geometric and architectural – structural explorations.

Due to the specific requirements of temporary objects often presenting unconventional solutions, the pavilions intrigue with their simplicity or application of the latest technologies. Pavilion designs have significantly contributed to the development of fabrication techniques and the construction of load-bearing structures using curved geometries. The design work undertaken in the field of small scale pavilions affect the fabrication at the conceptual stage. Architectural practice is a series of attempts by architects to test modern materials or building techniques. Experimental pavilions become important testing and research grounds. In designing a relatively simple function, with smaller formal constraints, it is possible to focus on solving specific implementation problems.

Nikolaus Pevsner writes that a pavilion is generally defined as a decorative object with a lightweight structure and that its main function is a resting place in a garden or a park, often as an element complementing the main building.[3]

The nature of exhibition pavilions is their connection with the environment, and the basic design principle is their ease of assembly and disassembly, in a short time and with a small amount of work. The word pavilion and butterfly are derived from the same root word in Latin: *papilio* (from Franconian pavilion-paveillon and butterfly-papillion), which was supposed to characterize their short-lived and mobile nature. The development of „temporary" architecture, which is characterized by high architectural quality, has intensified the development of modern technologies, which, depending on who uses them, lead to unique architectural forms.

The issues addressed by architects are:

- different use of digital tools using biomimetics and mathematical algorithms in the search for optimal shapes, behavioral systems;
- methods of fabricating building elements, along with the appropriate design of the shape of the pavilion cooperating with the chosen material, the method of preparing the elements for easy assembly;

[3] N. Pevsner, *Dictionary of Architecture and Lanscape Architecture*, Penguin Books, London 2000.

- searching for the minimization of energy necessary for the production of components, the use of environmentally neutral materials or as degrading the natural environment to the smallest degree.

P. Jodidio in the book „The New Pavilions”[4] introduced the division of small scale pavilions on the basis of their superior function: places of gathering (e.g. Serpentine pavilions), works of art, experimental objects (projects of research teams working in leading science centers), exhibitions, listening/viewing locations, objects with a longer duration and determined main function (for work, play, temporary residence), and shelter.

2. SERPENTINE PAVILIONS

For the last 19 years, the Serpentine Pavilions have an important place for crowds of visitors to gather every season. The cycle of exhibitions began with the roof designed by Zaha Hadid for the party organized by the gallery in 2000. Due to legal restrictions, the pavilion was to be erected for one evening and then dismantled, but due to its uniqueness, it was left for two months (during summer holidays). This event was an impulse for the design of pavilions in the following years, which already were an integral part of exhibitions in the existing gallery building.

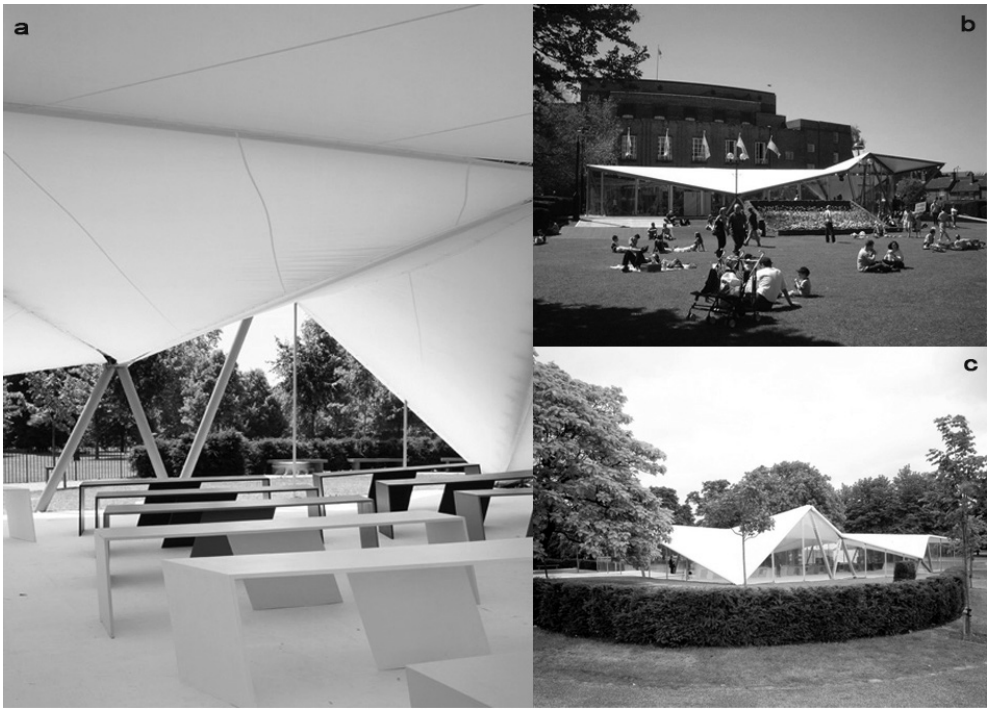
The Serpentine Gallery is located in the gardens of Kensington, in Hyde Park, London. Initially, the gallery built in 1934 was a tea house-pavilion. It was not until 1970 when the Arts Council of Great Britain established the pavilion as a gallery of contemporary art. At first only temporary exhibitions took place in the summer months. By the end of the twentieth century, it was decided to invite not only artists but also architects to participate in organizing the exhibitions. Zaha Hadid was asked to design an object that would reflect the contemporary character of the exhibitions, as an extension of the gallery pavilion, with the aim of being used for a party organized as part of the exhibition.

During the design, the author was searching for a modern tent or circus roofing, with an intriguing architecture, despite a limited budget (about 750,000 British pounds). The object proposed by Zaha Hadid consisted of a set of triangular panels supported by a steel structure. The designed pavilion had about 600 m^2. The corrugated form of the triangular roof panels, parts of which were transparent and parts of which were made of opaque PVC fabric, gave the illusion of a solid, durable construction, not reminiscent of the typical temporary tent structures used in outdoor events. The materially diversified elevation allowed for the pavilion to „open” to the surrounding nature, which was a kind of extension and visual enrichment of the interior of the pavilion, addressed to those visiting the park.

Thanks to the invitation of recognized architects from around the world from their early years, the advantage in the creation of the Serpentine Pavilions was the opportunity to use the latest achievements of interdisciplinary knowledge and computer-aided design. Modern digital tools are irreplaceable in the process of data processing both in creating the architectural form, as well as in the structural or material optimization. Since ancient times, architecture has been subordinated to the rules of logic and geometry, and its beauty was determined by canons. Contemporary analytical design does not depend on such specific orders. It is a pro-

[4] Judidio P., *The New Pavilions*, Thames & Hudson, London 2016.

cess of „logical thinking and consistency of intentions”[5], in which the use of computer aided design is often the only way to achieve a real goal in a planned architectural concept. The use of generative tools has introduced many significant changes to the design: „The new way of architects working alongside computers slowly shapes a new style in architecture, where an innovative, often surprising appearance is based on rules, algorithms and parameters.”[6]



Ill. 1. Summer Serpentine Pavilion by Zaha Hadid, 2000: a) interior, b) c) exterior perspective views of the pavilion’s form

Summer pavilions designed in 2010, 2011, 2012 were characterized by analyses and vibrant architectural discussion about materials, design methods, or even search for historical context for temporary designs. Jean Nouvel, an architect who designed the summer pavilion in 2010, proposed using recycled materials that could be recycled again. The choice of material was key to the entire project. The use of plastic and fabrics contributed to eco-friendly solutions. The pavilion was distinguished by its vivid red color, important to Londoners (buses, telephone booths). Jean Nouvel interpreted temporary architecture through the use of materials that cannot be used in stationary architecture.

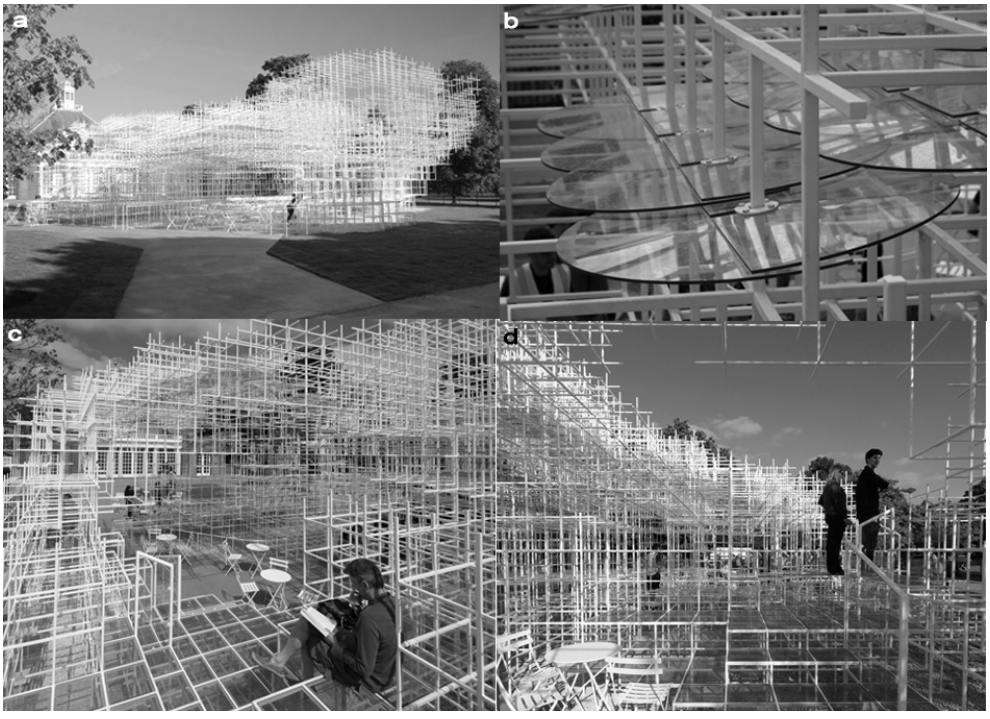
Peter Zumthor designed the 2011 pavilion as a black rectangular cuboid with an inner garden in the atrium by analyzing the way sunlight affects the perception of architecture. In order to get to the inner garden, one had to go through a corridor that was almost completely

[5] Stolarkiewicz M., *Komputer jako elektroniczny partner projektowania*, Architecturae et Artibus, 2011, no. 3.
[6] *Ibidem*.

deprived of daylight and artificial lighting. A garden full of various colorful flowers was designed in the center of the inner courtyard which was surrounded with tables and seats under a roofing. This created a contemplative space focused on nature.

Designers of the 2012 summer pavilion – Herzog & de Meuron referred to the gallery's historical context. They referred to an earlier pavilion by SANAA, by creating a flat roof filled with water. The whole narrative of the pavilion took place below the ground level. In order to visit the pavilion, one had to go down the stairs, where seats, an auditorium, changes in height, single seats were placed – dictated by the reconstruction of the shapes and foundations of all previous pavilions.

Until 2019, three pavilions were designed by Japanese architects, each of them distinguished by a specific take on the subject. Toyo Ito looking for inspiration in algorithmization (the oldest generation), SANAA emphasizing the significant impact of the environment and the way the temporary objects are inscribed into context and Sou Fujimoto, who in his professional practice often asked the question about the differences between nature and man-made architecture, designed an object without a roof, without walls, not competing with the surroundings. Undoubtedly, choosing a park for the site when designing the pavilion affected its design. The authors explained that the semi-transparency, which gave the impression of the object hovering above the ground, immersed the object in the surroundings. The pavilion with an area of 357 m^2 was built entirely of 20 mm square steel pipe mesh. The pavilion created a cloud that was supposed to show a project made using digital tools and at the same time point to the elements of nature. Inside, the authors designed a meeting space and an auditorium.



Ill. 2. Summer Serpentine Pavilion, SANAA, 2009: a) d) perspective view (gallery building in the background), b) a bird's eye view, c) a perspective view (park in the background)

In addition, polycarbonate fillings were placed in parts of the structure, serving as stairs or seating. Round polycarbonate panels were placed in the upper part of the pavilion, designed to protect against the rain and to reflect the heat of the sun.

Sou Fujimoto was the first of a generation of young architects who worked with the Serpentine gallery. The reason why the gallery did not commission the pavilion designs to young architects was the assumption that the summer pavilions, after the summer season, needed to be sold due to the low budget of the gallery. The gallery managers, fearing that the pavilions designed by young architects would not sell, had been commissioning only the most well-known and reputable architects. It was a great surprise that the pavilion in 2013, designed by Sou Fujimoto, was the most-visited exhibition in the world. This success contributed to commissioning the younger generation architects in later years. An example of a pavilion, which was made by a young design office from Madrid, was a pavilion from 2015 designed by Selgas Cano.

During almost 20 years of the summer pavilions, the recognition of the Serpentine Gallery grew significantly, which also had positive effects on the development of the exhibitions themselves. The emerging non-standard pavilions are also an opportunity to analyze the design ideas of leading architects, and thus they are exhibits of technological and intellectual possibilities, in which technical or material solutions, surprising in their simplicity, have been applied. Due to the increased interest in the gallery, it was possible to revitalize it and make it more attractive.

4. EXPERIMENTAL PAVILIONS

The 21st century is the time to explore visionary or even futuristic architectural concepts in search of innovative solutions. In the changing architectural environment, the technological and material changes require quick design and construction tests. Exhibition pavilions present unique opportunities to review the creative solutions of contemporary architectural problems. What seemed unfeasible in the twentieth century architecture now is nearly second nature and can be built, „The contemporary period is the time of various explorations, in the absence of legibly defined and generally binding principles, but also attempts to create new values."[7] Architecture as the art that is most resistant to stylistic changes – due to the nature of its formation – begins to follow the rapid rate of changes visible, among others, in fashion. The development of digital tools which support both the design and construction, as well as the supervision over the building throughout its lifecycle increasingly affects the quality of modern architectural solutions.

Examples of centers where research on the possibilities of interdisciplinary design provided by small scale objects are being carried out include, among others, MIT or the University of Stuttgart. Achim Menges describes the possibilities of discovering modern technologies in design in such words: „an interdisciplinary approach based on integration of architecture, engineering and biology influences the formation of extremely efficient buildings that

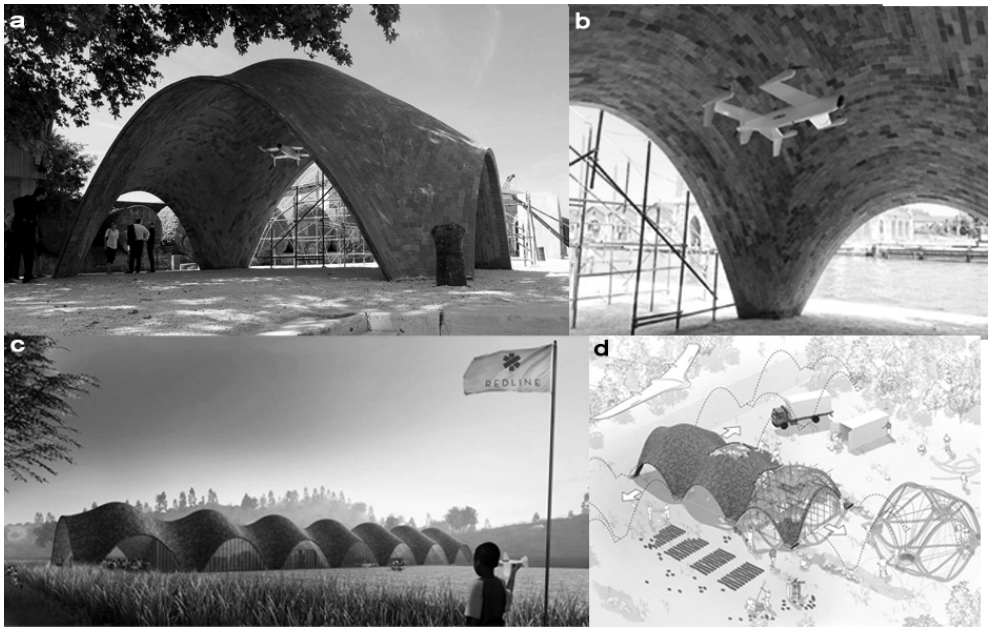
[7] Rokicki W., *Konstrukcja w aeurytmicznej architekturze*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006: „Okres współczesny to czas różnych poszukiwań, przy braku czytelnie ustalonych i ogólnie obowiązujących zasad, ale także próby tworzenia nowych wartości."

simultaneously offer unique spatial solutions". During the development of the pavilions, the possibilities of material optimization are investigated, not only in regards to the rational use of traditional materials, but also the use of unconventional materials, not yet identified with their use in architecture. The next phase of research is computer aided design, in which topological, structural and pro-ecological optimization is possible. The use of algorithmization, whether taken from mathematical or bionic formulas serves as a tool for multivariant optimizations. An additional advantage of the use of computer-aided design is the ability to prepare the pavilion elements for assembly, traditionally often omitted in technical documentation consisting of two-dimensional drawings. Instead file2factory files read by plotters, d3 printers or robots can be prepared.

The research center in which research on multi-variant optimization is carried out is the architecture department at the Polytechnic University of Zurich (ETH Zurich). An example of their pavilion is the Armadillo Vault ("Beyond Bending") at the Venice Biennale in 2016. The object is an example of optimization of the structure through the best use of the properties of the materials used. Blocks made of natural stone were the basic building blocks, laid on temporary boarding, without the use of mortar or glue, cut according to the prepared file2factory files. The basic task was to design the shape of individual elements and the entire roofing so that only compressive forces would occur in the structure, which would enable stone blocks to transfer the weight of the entire structure to the supports. The pavilion's span was 16.0 m, while the thickness of the elements at the highest points of the roofing did not exceed 5 cm. The creators compare these dimensions to the proportions that can be found in a chicken egg.

Ill. 3. Armadillo Vaoult designet at ETH in Zurich a), b) perspective view, c) material detail, d) fabrication process

Norman Foster's studio invited researchers from many research centers around the world (among others from the Politecnico di Milano, MIT at Cambridge, and ETH in Zurich) to cooperate on the project of a drone port in Africa. The main design issue was the usage of local materials – rammed earth and bricks. As an additional criterion, the project was to be constructed by local workforce and the construction technology had to be adapted to basic skills and technical back-up. The designers were tasked with creating a modular project. The prototype of the „smallest airport in the world" was presented at the Biennale in Venice in 2016. The film recorded during the assembly of the prototype later served as assembly instruction.



Ill. 4. Project of "the world smallest airport"designed by Foster&partners, 2019, a) exterior perspective, b) interior perspective, c), d)visualization of the concept

5. CONCLUSION

The growing interest in the emerging temporary objects is a new opportunity for the development of temporary architecture on a much larger scale than before 2000. The fleeting nature of exhibition pavilions prompts architects to boldly experiment with the use of new materials, but also to adapt traditional materials for completely different technologies. V. Abloh, analyzing the contemporary work of designers, notes that architecture has challenged designers to make decisions and work on non-existent issues – as architecture spontaneously attempts to face issues unknown to itself: „As designers, we're the thinkers; we're the ones who have to challenge all these generational decisions. But first: Does it need to exist? It's okay to say no." By analyzing the unique pavilion objects, one can observe the innovative,

often unconventional, creative ideas of architects. An extraordinary advantage of the small scale pavilions is their lack of a utilitarian function, which allows designers to individually interpret the assigned creative design tasks.

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