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EXPERIMENTAL ARCHITECTURE. INTUITIVE SEARCHING FOR INNOVATIVE SOLUTIONS OR A RATIONAL ATTEMPT TO SHAPE THE ARCHITECTURE OF THE FUTURE

ARCHITEKTURA EKSPERYMENTALNA. INTUICYJNE POSZUKIWANIE INNOWACYJNYCH ROZWIĄZAŃ CZY RACJONALNA PRÓBA KSZTAŁTOWANIA ARCHITEKTURY PRZYSZŁOŚCI

Abstract

Robert Kronenburg in *'Portable Architecture, Design and technology'* emphasizes that experimental design created to shape new, innovative design forms is an integral part of many industries, especially in the aviation and automotive branch. In architecture, assembly of full-size prototype objects in order to develop a specific design branch is still a rare phenomenon. Mock-ups are created in order to test material, aesthetic and security solutions. This article focuses on the present and experimental approach to shaping architectural objects from portable structures to biomimetic solutions and the confrontation of the intuitive and rational design approach.

Keywords: experimental design, innovation in architecture, biomimetic, mobile architecture

Streszczenie

Robert Kronenburg w książce *Portable Architecture, Design and Technology* podkreśla, że projekty eksperymentalne tworzone w celu kształtowania drogi do nowych, innowacyjnych form projektowych są integralną częścią wielu gałęzi przemysłu, szczególnie w branży lotniczej i samochodowej. W architekturze budowa i montaż pełnowymiarowych obiektów prototypowych w celu rozwijania danej gałęzi projektowej jest wciąż zjawiskiem rzadkim. Tworzone są tzw. *mock-upy* w celu testowania danych rozwiązań pod względem materiałowym, estetycznym oraz bezpieczeństwa. Celem artykułu jest przedstawienie eksperymentalnego podejścia do rozwiązań architektonicznych od struktur przenośnych (ang. *portable*) do obiektów biomimetycznych oraz konfrontacja danego podejścia projektowego z zagadnieniem intuicyjności i racjonalności.

Słowa kluczowe: projekty eksperymentalne, innowacje w architekturze, biomimetyka, architektura mobilna

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1. Introduction

Experimental architecture is not a trend that has only emerged recently. The search for innovative forms, optimal functional and spatial, material and construction solutions, has been noticeable since the beginning of the shaping of human settlements. Nomadic residential structures enabling the functioning of the first social groups in extremely difficult climatic conditions, such as Tuareg tents, Kyrgyz yurts, *tupiq* and *igloos* Inuit structures. These first nomadic structures were a kind of experiment that can now be classified as a *low-tech* trend. Monumental ancient buildings or the phenomenon of Gothic cathedrals were an experimental search and even transgression of architectural solutions at that time. Piotr Wróbel in the article *Eksperyment w architekturze. Wolny wybór czy konieczność i obowiązek* (*Experiment in architecture. Free choice or necessity and duty*) asks a rhetorical question “is the experiment something peculiarly modern or is it a constant element of culture?”¹.

In the 20th and 21st century as a result of technological revolution and the possibility of implementing electronic solutions to the structure of the object, a number of implementations that go beyond architecture as traditionally understood have appeared. An important question should be asked: is the experiment in the context of architecture an intuitive search for innovative solutions or a rational attempt to shape the architecture of the future? Is there a kind of dialogue between intuition and rationality? In the aspect of philosophical considerations, the concept of intuition was attributed to various properties, including definitions such as a sensual or intellectual point of view, proportional and disproportionate knowledge, intellectual and sensual disposition, placing the concept of intuition in the sphere of consciousness and unconsciousness². Rationality should be distinguished from the philosophical concept that is rationalism, which defines mind as a high value, both cognitive and moral³. One of the leading philosophers of the 20th century, Martin Heidegger, refers to the concept of rationality: ‘perhaps there is a more sober thought than the unstoppable momentum of rationalization, more sober than the rousing current of cybernetics. Probably it is the most irrational’⁴.

The main aim of this article is to present an outline of experimental and innovative trends in architecture at the turn of the 21st century and to confront this approach with the issue of intuitiveness and rationality (ill. 1).

¹ P. Wróbel, *Eksperyment w architekturze. Wolny wybór czy konieczność i obowiązek?* (*Experiment in architecture. Free choice or necessity and duty?*) Państwo i Społeczeństwo, Czasopismo Krakowskiej Akademii Andrzeja Frycza Modrzewskiego, no. 1 (XVII), Cracow 2017.

² Selected definitions of the concept of intuition are the part of the publication of Monika Walczak: *Intuicja jako typ poznania, wiedzy i dyspozycji* (*Intuition as a type of cognition, knowledge and disposition*), Komitet Naukoznawstwa PAN Publishing.

³ K. Stachewicz, *Kilka uwag o racjonalności. Wprowadzenie* (*A few remarks on rationality. Introduction*), [in:] *Osoba i Racjonalność, Filozofia Chrześcijańska*, vol 6, Poznań 2009.

⁴ M. Heidegger, *Koniec filozofii i zadanie myślenia*, [in:] R. Ilnicki, *Religia i technonauka* (*Religion and technoscience*), Przegląd Religioznawczy, no. 1 (239), 2011.

2. Mobile architecture

Movement has accompanied man from the beginning of his existence. Mobility is the motor of the dynamization of humanity. The contemporary transformation of the concept of nomad and the emergence of the term 'neo-nomadic', which can be considered also in the context of virtual reality and cyberspace, is significant. Human mobility is a multidimensional concept. The sociological and psychological aspect of mobility is widely discussed by John Urry, author of *Sociology of mobility*, in which he describes dynamic social changes in the era of globalization⁵.

The motive of movement in architecture gradually developed depending on the technological and historical context. In the 20th century, numerous concepts of complex cities and utopian megastructure buildings were created, which was closely related to the fascination with the prospect of unlimited technological development.

2.1. From the conception of the walking city to the implementation of portable structures

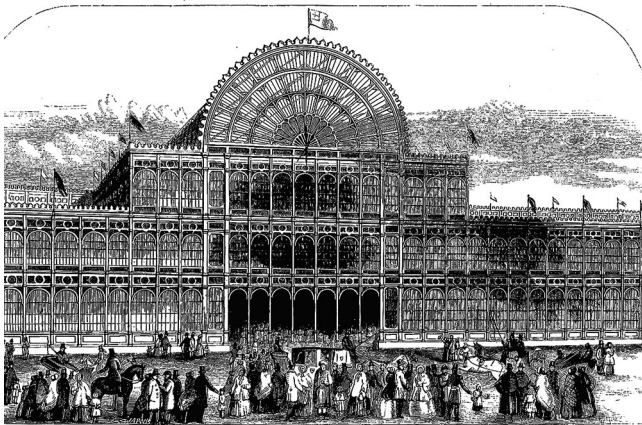
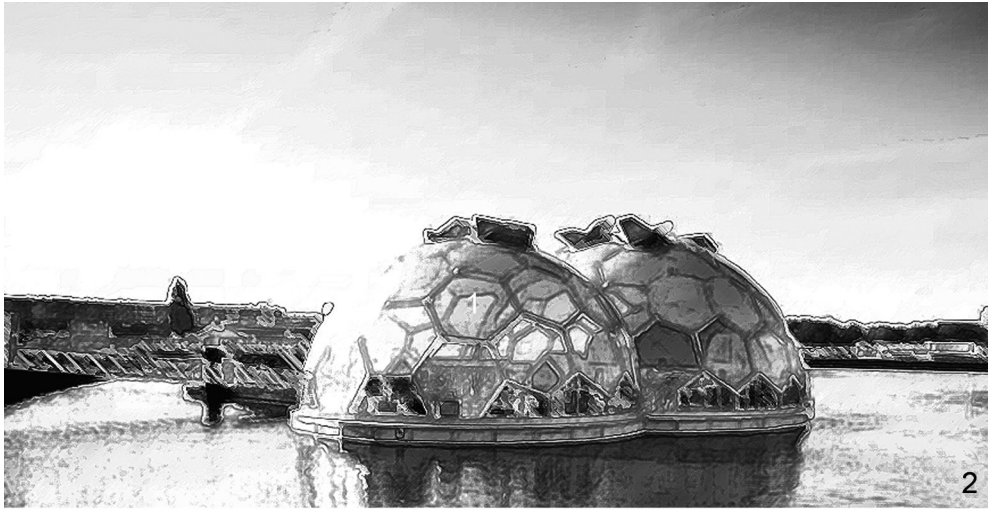
At the beginning of the 20th century, European architecture was shaped under the influence of the international style solutions which were unique at that time. At the same time, Futurism, contesting the architectural historical heritage, was particularly reflected in the manifesto of Futurist Architecture by Antonio Sant'Elia. The second half of the 20th century brought a series of international-scale utopian visions that were influenced by the motive of dynamics, mobility and design assumptions of adaptable structures. The activities of Yona Friedmann and the GEAM group, Archigram, the Japanese Metabolists and the Superstudio group were particularly important. The direction and experimental research in architecture was also influenced by the projects and realizations of Richard Buckminster Fuller, mainly from the *Dymaxion* series⁶.

2.2. The experimental floating pavilion in Rotterdam

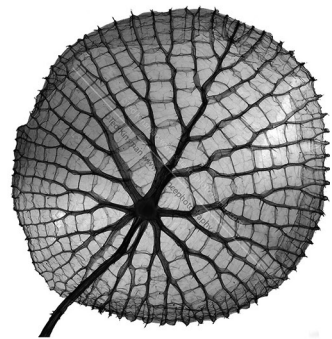
The turn of the 21st century brought the theme of movement in architecture to the level of addition, searching for solutions for portable objects that are fully autonomous or *off-grid* were underway. The floating exhibition and conference pavilion in Rotterdam deserves particular attention in the context of mobile structures in the aquatic environment. The building was created as the result of an experiment that was a response to the deepening climate changes and the rising sea levels. The structure of the building consists of three hemispheres connected structurally and functionally, founded on a floating foundation anchored in the old city port. One of the long-term perspective plans of the city of Rotterdam is the full

⁵ J. Urry, *Socjologia mobilności (Sociology of mobility)*, Wydawnictwo Naukowe PWN, Warsaw 2009.

⁶ A. Berbesz, *Motywy ruchu w architekturze. Architektura mobilna stacjonująca tymczasowo jako alternatywna próba kształtowania obiektów architektonicznych na podstawie wybranych przykładów z przełomu XX/XXI w. (Theme of movement in architecture. Temporary and mobile structures as an alternative attempt to shape architectural objects on the basis of the selected examples from 20th and 21st century)*, Wrocław 2016, doctoral dissertation on the typescript rights.



VIEW OF THE GRAND ENTRANCE TO THE EXHIBITION.



EXPERIMENTAL ARCHITECTURE [selected examples]



PORTABLE,
MOBILE AUTONO-
MOUS AND OFF-
GRID STRUCTURES

BIOMIMETIC AND
BIOMORPHIC SOLU-
TIONS

KINETIC AND RE-
SPONSIVE ARCHI-
TECTURE

PARAMETRIC
DESIGN AND IN-
TERACTIVE AR-
CHITECTURE

LOW-TECH ARCHI-
TECTURE

adaptation of the coast to the phenomenon of constant sea level rise. The main idea is to create a complex of floating houses, and the first prototype is a floating exhibition pavilion. The outer cladding of the structure is a transparent, anti-corrosive ETFE material. Deltasync and PublicDomain Architects were responsible for the architectural design⁷ (ill. 2).

3. Biomimetics and biomorphism in architecture

Nature perfectly uses the motif of movement, which can be observed in both the animal and plant world. Charles Darwin had observed plants performing noticeable movements called nutation movements⁸. Optimization of solutions found in nature has become an inspiration for the developing fields of science, i.e. bionics and biomimetics, as well as for biomorphic solutions in the field of engineering, including architecture. Biomimetics deals with transposing solutions in nature to engineering. Biomorphism is based on the imitation of natural forms found in nature.

One of the best-known examples of using biomorphic solutions was *Lily House* from 1850, and then *Crystal Palace* from 1851 designed by Joseph Paxton. In both buildings, the inspiration of the outer structure was the water lily (*Victoria Amazonica*)⁹ (ill. 3).

An example of the use of biomimetics in architecture is the implementation of kinetic façades of buildings referring to stomata of plants. Such examples are the facade of Al Bahar Towers in the United Arab Emirates or the Esplanade Theaters on the Bay in Singapore. One of the groups which deal with biomimetic-based projects is The Terreform One research group [Open Network Ecology] which is an interdisciplinary research platform to create innovative concepts and prototypes in accordance with the assumptions of sustainable development. Concepts and realizations are related to mobility, urban planning, architecture, and spatial art¹⁰.

Spatial installations on the border of art and architecture have been moved to a higher level by Philip Beesley, who creates projects based on interdisciplinary cooperation in the fields of chemistry, biology and visual arts. His realizations from the *Hylozoic* series are an example of the use of biomimetic and responsive architecture¹¹.

⁷ Internet source: <https://inhabitat.com/rotterdams-floating-pavilion-is-an-experimental-climate-proof-development/>, access: June 8, 2018.

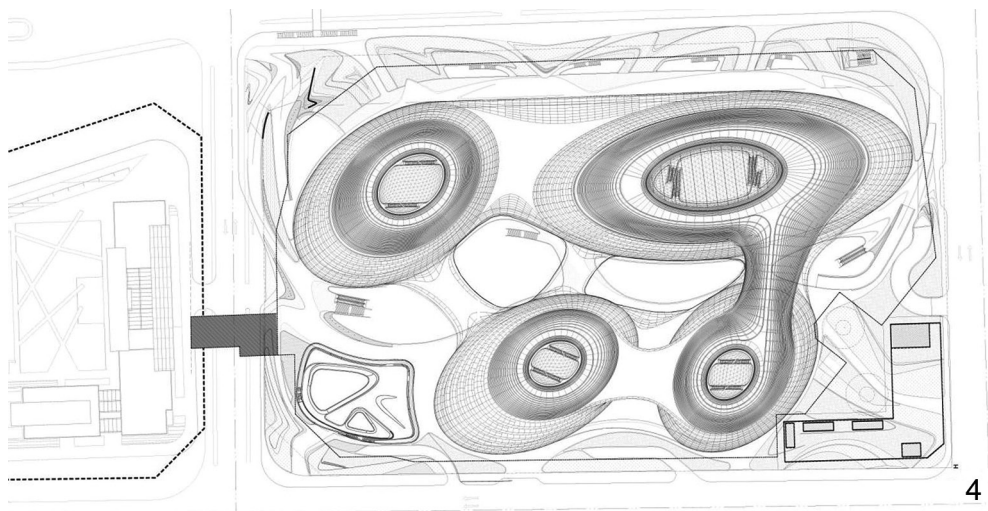
⁸ D. Chamowitz, *Zmysłowe życie roślin (What a Plant Knows: A Field Guide to the Senses)*, Grupa Wydawnicza Foksal, Warsaw 2012.

⁹ Internet source: <http://www.engineering-timelines.com/scripts/engineeringItem.asp?id=725>, access: June 8, 2018.

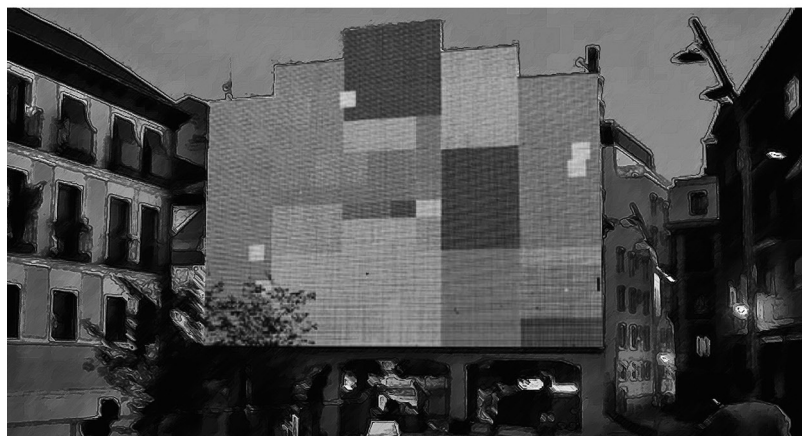
¹⁰ Internet source: <http://www.terreform.org/projects.html>, access: June 8, 2018.

¹¹ P. Beesley, O. Khan, *Responsive architecture. Performing instruments*, vol 4, The Architectural League of New York, New York 2009.

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- Ill. 1. Schematic division of selected trends in experimental architecture
Ill. 2. Floating conference and exhibition pavilion in Rotterdam, based on: <https://www.thestar.com/life/travel/2016/06/24/rotterdam-embraces-water-in-eye-catching-architecture-minded-ways.html>
Ill. 3. Facade of the Crystal Palace designed by Joseph Paxton as an inspiration with a water lily (lac. *Victoria Amazonica*), based on: <http://www.ndl.go.jp/exposition/e/data/L/0051.html> oraz <https://tedkinsman.photoshelter.com/image/I0000k0DCYKbKRkg>



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4. Kinetic and responsive architecture

The kinetic and responsive architecture is nowadays not only an experimental design approach but an attempt to rationalize energy gains and losses within the designed building. The concept of kinetic architecture was formed in the 1970s and for the first time appeared in the book *Kinetic architecture* written by W. Zuk and R. H. Clark¹². The concept of responsive architecture appeared in parallel and was first used by Nicholas Negroponte and the Architecture Machine Group of MIT. Currently, it is possible to implement electronic systems within the designed building on a large scale. One of the most widespread systems is the CABS (*Climate Adaptive Building Shells*), the main task of which is to provide optimal thermal conditions inside the building through appropriate control of the facade system¹³.

5. Parametric design and interactive architecture

Patrik Schumacher, currently acting director of Zaha Hadid Architects, in 2011 published a controversial book *The Autopoiesis of architecture. A New Framework for Architecture*¹⁴. It is considered to be an original manifesto for parametric architecture in which the author announces a completely new shaping of form and generation of architecture. Nowadays, as a result of advanced construction technology, it is possible to implement geometrically advanced forms. This means that the transformation of design tools is also following the technological development. The core of the concept of parametric architecture is the word 'parameter'. It is the parameters that determine the many variables concerning, e.g. the energy demand of the building, the optimal sun exposure, perfect acoustics, and the properties of wind directions and atmospheric pressure. Moreover, traditionally understood architectural drawing entered into the field of mathematical algorithms and exceptional precision. Parametric programs, such as *Grasshopper*, *Rhinoceros*, and *Monkey* are currently used for design. Parametric architecture balances on the border of architecture and art thanks to such personalities as Zaha Hadid, Fernando Romero, and Frank Gehry¹⁵ (ill. 4).

¹² W. Zuk, R. H. Clark, *Kinetic architecture*, Van Nostrand Reinhold, 1970.

¹³ R. C. G. M. Loonen, M. Trčka, D. Cóstola, J. L. M. Hensen, Climate adaptive building shells: state-of-the-art and future challenges [in:] *Renewable and Sustainable Energy Reviews* 25 (2013), p. 483–493.

¹⁴ P. Schumacher, *The Autopoiesis of architecture. A New Framework for Architecture*, vol. 1, Wiley, 2011.

¹⁵ Internet source: <https://www.morizon.pl/blog/architektura-parametryczna/>, access: June 8, 2018.

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- III. 4. The Galaxy Soho building designed by Zaha Hadid Architects as a leading example of parametric architecture, based on: <https://www.archdaily.com/287571/galaxy-soho-zaha-hadid-architects>
 - III. 5. Interactive facade at the Plaza de las Letras with the use of Philips iColor Flex technology, based on: <https://www.arquitecturayempresa.es/noticia/medialab-prado-un-laboratorio-ciudadano>
 - III. 6. The experimental building of the Domaine de la terre housing estate in France on the initiative of the CRAterre research center, based on: <http://diaconti.com/la-terre-en-mouvement/>

On the border of art and architecture there are also interactive solutions which in the context of architecture particularly refer to the facades and walls of buildings. One of the most spectacular examples of realization is the interactive wall of the building at the *Plaza de Las Letras* in Madrid (designed by María Langarita and Víctor Navarro). To create a unique interactive wall surface, the Philips Kinetic iColor Flex solutions were used. The main idea of the project was to create a meeting point for generations, the possibility of sending information and creating an interactive medium. The result is a unique public square with the use of the façade elevation on the light screen, which increases the possibility of sensory experience (ill. 5).

6. Low-tech architecture

Low-tech architecture has accompanied man from the beginning of human settlements. The creators intuitively chose local, easily accessible, unprocessed materials. One of the first basic materials was earth. Some construction techniques based on the use of material such as earth currently are still in use.

Teresa Kelm, in the book *Earth Architecture. Tradition and contemporaneity*, claims that 'earth architecture is not only the technology and way of constructing buildings. Earth is also a culture-forming material with an extraordinary plasticity, sculptural, capable of adapting to climate change, geographic, technological and aesthetic requirements. From forms in a basic way adapting to the environment and living conditions in traditional construction to forms of the most sophisticated comfort and standard in contemporary realizations'¹⁶. Earth architecture is the basis for shaping objects from natural materials. At the turn of the 21st century there was a special shift towards the use of natural materials in the aspect of the experimental approach. This phenomenon is the result of greater interest in designs based on energy-saving and pro-ecological architecture.

In 1979, the international centre of earth architecture CRAterre was founded. This interdisciplinary research centre focuses on three main goals related to the optimization of the use of local natural resources, improvement of the quality of life and housing conditions and promotion of cultural diversity¹⁷. One of the leading CRAterre projects was the implementation of the Domaine de la Terre housing estate in France in the early 1980s. The main idea was to show the diversity of the use of structural solutions based on earth techniques. The housing estate consists of twelve buildings designed by different architects using modernized techniques, i.e. pisé de terre, pressed blocks and a skeleton structure filled with soil¹⁸ (ill. 6). *Low-tech* architecture seems to stand in opposition to the technical world. It encourages the designer to experiment with the material and to search for a balance between architecture and nature.

¹⁶ T. Kelm, *Architektura ziemi. Tradycja i współczesność (Earth Architecture. Tradition and contemporaneity)*, Oficyna Wydawnicza Politechniki Warszawskiej, Warsaw 2014, p. 10.

¹⁷ Internet source: http://craterre.org/?new_lang=en_GB, access: June 8, 2018.

¹⁸ D. Easton, *The Rammed Earth House*, Chelsea GQGreen Publishing Company, 2007.

7. Experimental architecture as a dialogue between intuition and rationality

The article only focuses on an outline of trends in contemporary architecture that can be treated as experimental, crossing the boundaries of traditional architecture. At this point, the question may be asked whether the above-mentioned crossing of borders, the constant search for new solutions is a fully intuitive or rationalized action. One could put forward the thesis that all new directions in architecture and art from the beginning of creative human activity were an experiment, a search for form, functionality, aesthetics, and structural solutions. Intuition is probably the basis, the driving force of change, the power of creation. Knowledge-based intuition is the domain of great artists, the foundation of timeless works. Rationality is required to optimize operations, choose the right material, carry out advanced design and implementation work. It seems that intuition and rationality should be a form of the internal dialogue of the creator, balancing project activities. The examples presented of experimental trends in the architecture of the 20th and 21st centuries show a holistic approach to the essence of architecture, interdisciplinary design activities, and an attempt to search for a dialogue between new technologies and traditional design activities. Are such activities only the result of intuitive decisions or even a rational analysis of the solutions undertaken? An unambiguous answer will probably not be possible. It seems, however, that only a compilation of intuition and rationality can lead to high-quality architectural realizations, continuous explorations, and creative experiments.

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