

The Relations Between Architecture and Nature – Contribution of Modernist Architects

Stanisława Wehle-Strzelecka

1. Introduction

The second half of the last century closed the period of an attitude towards the natural environment which was dominated by anthropocentrism, referred to as the “era of economics” or the “machine age”. A possibility of initiating a new, environment-friendly culture opened up, aiming towards a model of life based on the principles of sustainable development, eco-development and biocentrism.

The aim of this publication is to remind about and present the contribution of the architects of the modernist period to the search for harmonious relations between the environment which was built and the natural surroundings, with particular emphasis on the associations of architecture with the place and the climate. Despite the contemporary, often critical, attitude to the mentioned period due to its excessive promotion of the industrial culture or the glorification of technology, the occurrence of numerous ideas and issues is observed, which prove sensitivity of architecture to nature, a search for a human contact with the environment by its creators, or shaping a healthy housing environment. The reference of architecture to the climate, the introduction of energy efficient solutions, including heliotropic housing estates, based on new technologies, and the possibilities of material and design, as well as a particular fascination with glass, can be regarded as the source of a variety of concepts of modern eco, energy efficient and sustainable engineering, and as a part thereof - the second generation of solar architecture¹.

Most generally, it can be stated that the modernist architecture was characterized by the search for answers to the numerous contemporary social needs, especially those related to an access to affordable, healthy, having aesthetic qualities, urban space, housing estate or functional accommodation. The artists of this period tended to form a new definition of architecture by putting the man and their health in the center of attention, as a key to the development of functional, economical and simple solutions. Modernism can also be characterized by a great interest and enthusiasm for the achievements of technology, new materials and construction.

2. The basis for development of a dialogue between architecture and nature in the twentieth century

The basis for modernism and contemporary transformations in the shaping of residential environment, as

well as opening it to the nature, was prepared by the periods preceding it. The inclusion of human settlements into the surroundings - the existing nature and, most importantly, the climate, has been known for thousands of years, and it is characteristic of many civilizations of the world for whom, fundamentally, each architecture was organic. A huge contribution to the dialogue between the built environment and the nature was made by ancient Greece and Rome, and these achievements were continued by Europe, especially in the period from the sixteenth to the late nineteenth century (including a variety of concepts of gardens, greenhouses, orangeries, and glass technology development)². The period of industrialization and the emergence of new technologies in the construction industry (ca. mid-eighteenth century) was marked by a clear move away from the principles of shaping the built environment with reference to the place, and this approach dominated the architecture of the twentieth century until its last decades.

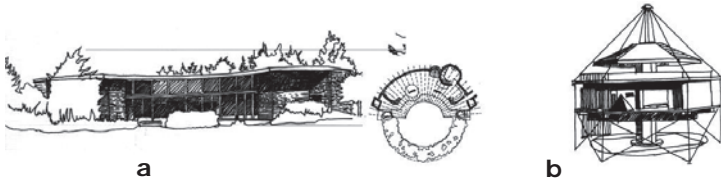
Before the year 1900, a variety of concepts and implementations of towns and residential areas, taking into account the health comfort and access to the sun, appeared on our continent³. From the Gregorian urbanism⁴, neo-Gothic, through the movement of Arts and Crafts and Art Nouveau, organic trend was developing. The works of A. Gaudi, the American ideas of L. Sullivan and F.L. Wright were deeply embedded in the context of nature. The last two mentioned architects identified the concept of architecture with its harmony of time and place in which it was formed, including the latest technological developments into their concepts at the same time. An example is the design of the Auditorium Building in Chicago (1886-1889) by L. Sullivan, which was the first building in the world connecting the electrical lighting system with mechanical ventilation. F.L. Wright was a master of integrating the systems of ventilation, artificial lighting and heating with the introduction of fire (fireplace) to the heart of the house with the architectural concept. Although his work developed over the decades outside the mainstream of modernism, his ideas of organicity influenced European architects, with a narrow stream appearing as part of the international style. They can be considered to be a counterweight to the aesthetics of the architecture of the “machine age” - modernism derived from Bauhaus of W. Gropius and M. van der Rohe, the creators of the European functionalism and the representatives of the “Chicago School”.

1. The concept of solar architecture is understood by the author as the energy-efficient architecture, the structure of which, and the way the outer and inner space is arranged, adequately to the climate, enable to derive the maximum heat gains from the sun's energy while ensuring minimal heat loss. It forms an integral whole with the elements that are used to gain solar energy in a passive manner, or both passive and active.

2. The classic understanding of organicity has been known since the Renaissance (the building and the city as an organisms).

3. Including Port Sunlight, the ideas of E. Howard, R. Unwin, A. Rey, T. Garnier. The technological achievements were proven, inter alia, by the concepts of: air conditioning in F.L. Wright's office in Buffalo with a glass atrium, 1902, a double transparent partition wall in the powerhouse of the Steiff company, 1903.

4. Royal Crescent, England, 1767-1771, among others.



1a. *The House in Middleton* (1946) – the “Solar semicircle” designed by F.L. Wright, b. “Dymaxion House” designed by R.B. Fuller. Author’s own work

3. Reference to the nature and the concept of using solar energy in European modernism

The early modernism (the years 1900-1920), was a period in the development of architecture and other arts, which was characterized by a retreat from the nineteenth-century historicism, and a search for rational urban concepts in response to social problems of the rapidly expanding cities, as well as the emergence of a need for social housing programs. As part of the implementation of the concept of industrial culture, modern structural and material solutions were sought, which could be applied in the design of large housing complexes. Hence the popularity of glass and concrete, which initially dominated the industrial and public architecture. The expressionists, P. Scheerbart and B. Taut, while developing their visions of a glass house, based them on their fascination with glass as a building material of the future. An example of a novel use of this material and its featuring in the form of a prismatic dome was the pavilion designed by B. Taut (with the aphorism on the façade: “Glass brings us a new era, building in brick only does us harm”, Werkbund Exhibition, Cologne, 1914)⁵. Also, the influence of A. Sant’Elia upon futuristic visions of architecture based on the fascination with technology, his towns and houses of the industrial design aesthetics should be mentioned (the dynamic city, *Città Nuova*, 1914).

The development of technology after World War I allowed for the mass production of large glass panes, of good quality and at a reasonable price. In the recognition of aesthetic qualities of this material, Mies van der Rohe (American pioneering projects in Chicago)⁶, as well as other artists of the Bauhaus (Gropius, among others) developed the studies of transparency in architecture. They were accompanied by advances in steel construction systems, acting as a frame, filled with a glass “skin”. The potential in the glass, due to a possibility of using it in the energy-saving solutions, was confirmed by the development of its technology in the next decades. New relations between a building and the natural environment through a glass partition, initiated with the work of B. Taut and M. van der Rohe, are being implemented today by contemporary large capacity climatic structures and the concepts of passive solar residential architecture.

The decade of 1920-1930 was marked by the development of socially engaged architecture and urbanism. Government investments enabled an explosion of residential construction of a good standard and low cost. Rational, cost-effective and technology-oriented material solutions were accompanied by a surge of interest in the use of solar energy and the greenhouse effect, as well as the health benefits of introducing southern glass façades. This type of implementations include mainly housing estates for the working class erected in the Netherlands, Sweden, Switzerland, but also in other European countries (the largest development – the housing complex in Switzerland - Neubühl near Zurich). The concept of orienting “linear urban layout” by the sun was promoted by J.J.P. Oud (Tussendijken housing estate, 1918 and Kifhoek, 1925, Rotterdam), as well as A. Loos (Heuberg housing estate in Vienna, with

a passive solar system, according to the concept of L. Migge, 1921-1922)⁷ and E. May (Am Römerberg, 1927 - 1929 and Westhausen, 1929-1931, Frankfurt). The German architects M. Breuer and W. Moltke, who introduced the walls of deciduous trees as natural shading of sunlit southern façades in summer, which soon became common practice and is used today in bioclimatic architecture, are considered to be the pioneers of the Renaissance of “solar design” after World War I. As part of the Bauhaus activity, studies on the optimal insolation of buildings were carried out (H. Meyer), a model of prefabricated solar house was sought as well. Large urban complexes, which were built in the late 1920s, were accompanied by the widespread implementation of the guidelines for the use of solar energy (implementations including W. Gropius - Dammerstock estate, 1928, in Karlsruhe, B. Taut and M. Wagner - estate in Britz, Berlin, 1925, M. van der Rohe - Weissenhof estate, Stuttgart, 1927). A popular system of development, called heliotropic, was characterized by long, low-rise buildings, parallel to each other. Its master example was, *inter alia*, Siemenstadt residential complex near Berlin (1929). Over time, long, total development systems, as uneconomical, were replaced by complexes created from small, insulated buildings with south orientation (projects by the architect H. Hering, among others). The research into the use of solar energy in architecture conducted by the Royal Institute of British Architects (1931-1932), whose development impeded an easy access to conventional energy sources after World War II, should also be mentioned here.

Polish examples of residential estates from this period include, among others, a general plan for the development of Bielany (Cz. Rudnicki, F. Klein, 1926), a housing complex in Żoliborz (J. Jankowski, A. Jawornicki, W. Weker, 1927) with parallel, sun-oriented buildings, the contest for a residential colony in Nowe Rokicie (R. Gutt, J. Jankowski, 1928) and in Polesie Konstakowskie (S. Monasterski, 1928) in Łódź, a housing development of the Ministry of Internal Affairs in Warsaw (J. Stefanowicz, 1930).

The concepts of residential architecture in the coming decades, resulting from the principles formulated at CIAM congresses as well as technological achievements, began to represent a more mechanistic approach to the housing environment. Despite such an assessment of the international style, it should be emphasized that the eminent artists and their selected works have contributed significantly to the continuation and enrichment of the dialogue between architecture and nature. Le Corbusier, inspired by the context of nature, looked for its relationship with the man (e.g. *Pavilion d’Esprit Nouveau*, a chapel in Ronschamp -

7. L. Migge installed glass gardens as a climatic cover. More in: R. Bauman, *Houses in greenery*, Warsaw, 1991, pp. 42-43, and K. Butti, J. Perlin, *Golden Thread. 2500 years of solar architecture and technology*, New York, 1980, p. 71.

2. A. Aalto, *Mairea Villa, Finland, 1938-1939*. Source: L. Lahti “Alvar Aalto”, p. 42



5. The inspiration was P. Scheerbart’s poetry. Cf. J. Tietz: *History of the twentieth century architecture*, Cologne, 2001, p. 19.

6. The most important was the design and material, a relationship with the environment was subordinated to the visual impact of the glass curtain.

1951-1955, Villa Savoye in Poissy, 1929-1931 - a conscious decision on the detachment of a structure contemplating the landscape from the interior and a terraced garden) from the surrounding. Also, many organic concepts of A. Aalto reflect an extremely personal attitude of the architect to human relations, technology and nature, differing from the typical patterns and principles of formal functionalism. Rooted in the tradition and nature of Finland, they are tailored to the scale and the human psyche. Their humanism, aesthetics, simplicity and harmony with the environment, prove a significant anticipation by the architect of the later demands of a holistic or ecological architecture from the late 1960s. They can be regarded as a model of exhibiting organic qualities of nature and fusion with the environment, which should be referred to in the shaping of a model of contemporary sustainable architecture (Fig. 2).

4. Relations between architecture and nature in the American mainstream

Although the conference is focused on the European modernism, one can not fail to reach here for the examples of the American architecture, because the creative activities on both continents remained in close interdependence, affecting each other both in terms of their approach to social problems and aesthetics, as well as the use of the technological achievements.

The above mentioned ideas of the European modernism, transferred to the United States, in conjunction with the local tradition, became a basis for a dialogue between architecture and nature, as well as for the development of the solar movement in this country no sooner than at the end of the 1930s, bringing great achievements in the coming decades. In turn, the influence of the American experiments in bioclimatic and organic architecture, the ideas of R. Neutra, M. van der Rohe, A. Saarinen, and the progress in the field of glass technology was significant, inspiring research and experiments in the implementation of architecture open to the environment in Europe.

R.J. Neutra made an important contribution in this field through research and experimentation, which he carried out in Los Angeles (including the Lovell Health House, 1928), seeking guidelines for integrating the inside of a house and its surroundings through glass panes protected by vegetation. As a follower of the ideas of organic architecture, with his works he created a bridge between the rationalism of German modernism and organic values of F.L. Wright's works. His philosophy of "bio-architecture" was based on a belief of the inseparable connection between the man and the nature. On the basis of the studies of local environmental conditions and local architectural tradition, he blended his structures into nature using glass as an element for the "dematerialization"⁸.

In the U.S., just like in Europe, solar architecture appeared in the form of waves, in response to the new crises, mostly energy ones. After World War I, along with the activities of big oil companies, slowing interest in energy efficient technologies occurred. The concept of solar homes for the climate of California was at that time developed by R. Schindler. Then, a research on models of different variants of a glass house began. The house acquired energy from the sun and was adapted to different climatic zones as well as to the possibilities of the construction industry and available technology. In the 1930s, the works in this field were conducted by the architect G.F. Keck from Chicago (a futuristic house with 90% of the walls made of glass, the Chicago World's Fair, 1933). Mass production of energy-efficient homes and new concepts in materials for housing construction were also the subject of experiments carried out by R.B. Fuller (Dymaxion House in Dearborn/Michigan, 1927), with a vacuum glass wall, air conditioning system and the first solar panels. A. Frey and L. Kocher also studied a possibility of constructing a house of aluminum (1930).

8. In addition to vegetation (vines and gardens), he introduced water to architecture ("psychological ponds") near the buildings and on rooftops.



3. Housing complex in Freiburg designed by R. Disch. Photo by the author

A progress in glass technology allowed for a construction of a number of passive houses, mainly in the Chicago area, in the 1930s and 1940s. They were characterized by southern walls made of glass, open to the winter sun, with shades protecting against the sun rays in the summer, and the Solar Park housing estate (a group of 30 houses) became the first completely oriented to the sun, modern housing complex of this type in the USA⁹. Also, F.L. Wright built a solar house (the second H. Jacobs's house, Middleton, 1946) with a semicircular winter garden (Fig. 1). It belongs to the projects which are characterized by "etherization" of architecture and the comfort of a contact between the man and the nature through glass partitions. The American search and achievements were focused much more on satisfying the social needs using modern technology in comparison with the proposals of the Bauhaus in Europe. It is proven by bringing to market solar houses with large southern façades made of glass already at the end of the 1940s. A success of A. Pilkington (1955) associated with a new technology of making smooth glass panes contributed to the manufacture of the elements of a larger size (float). An inspiring role in the use of this material was played by M. van der Rohe's architecture and popular solutions such as "skin and bones" ("beinahe nichts"), as well as the contribution of A. Saarinen and his experiments on the glass façade shading systems. M. van der Rohe, although it was not his purpose to create a symbiosis of the form with nature, developed the concepts of etherization of architecture and its "dematerialization", the continuity of the interior and the surrounding, as well as the contact with nature without barriers. These achievements opened the way for the later solutions and for the technologies currently used in the construction of the glass and solar façades. This is, among others, evidenced by the designs of the contemporary architects of the technologically-orientated Eco-Tech" architecture, as well as the bioclimatic concepts.

For today's environment-friendly architecture, the research works on the development of new technologies for residential construction using solar collectors for heating purposes, conducted since 1938 for two decades at the Massachusetts Institute of Technology (four different experimental houses: 1940, 1947, 1949 to 1953, 1958), were also quite significant. During this period, the production of photovoltaic cells began as well. A contribution to the futuristic visions of energy-saving forms was made by R.B. Fuller, presenting the concept of the climatic glass dome over Manhattan (1960). On the basis of the studies of the native forms of construction, the first implementations of bioclimatic houses in the south-western regions of the United States occurred, with reference to the building tradition of the Indians as well as the Spanish settlers (Spanish Pueblo Style). Traditional architecture was also an inspiration for many prominent architects in the 1930s (R. Schindler, R.J.

9. The term "solar home" first appeared in 1940 in connection with the implementation of H. Sloan's house in Chicago, according to G.F. Keck's design.

Neutra, F.L. Wright). As part of the solar movement (the first wave) from the 1940s, these solutions were also promoted by S. Baer, D. Wright, W. Lumpkins, S. and W. Nicols. During the 1950s, the theory of bioclimatic architecture and the ideas of energy-efficient solutions related to the environment, climate and native materials were further developed quite consistently.

5. Summary

The works of the architects of the period of modernism, as mentioned in this paper, through the continuation of the achievements of the past eras, have contributed to the continuity of the dialogue between the nature and the architecture, as part of the unified trend determined by the international style. Over the next decades, they formed the grounds for the emergence of various concepts of integrating architecture with the natural surrounding as well as the search for the forms of a human life and the development of the environmental and eco-energy trends balanced with it. The contribution of the eminent architects should be mentioned here, such as: P. Soleri, F. Otto, M. Wells (the pioneer of the idea of architecture embedded into the surrounding and of the glass domes acquiring energy – a reminiscence of Fuller's works), T. Ando, R. Erskine, E. Greene, A. Isozaki, L. Kroll, K. Kurosawa, J. Nouvel, R. Piano, T. Herzog, S. Calatrava and R. Rogers¹⁰, N. Foster, N. Grimshaw – the three authors of aesthetics and philosophy of Eco-Tech.

It should be noted that the fascination of, and the inspiration with, the technology, characteristic of modernism, is still present, evolving in response to the progress in the field of the increasing construction and material possibilities. It is evidenced by the projects including energy-efficient houses and estates, using the solar energy and the concepts of the European solar cities (Linz - Pichling, Austria, Potsdam, Regensburg, Germany).

What concrete, steel and glass was for modernism, today, at the threshold of the era of ecology, has been replaced by solar technology and a search for new materials. They are developing in various directions: a search for artificial intelligence analogous to biological one, creating forms at the boundary between digital technologies and biology, the theory of folding (the architect P. Eisenman - Ciudad de la Cultura de Galicia, near Santiago de Compostela, Spain, 1999) and the use of bionics. The studies on living organisms contribute with the knowledge that is applicable in many fields of science, and therefore in the above-mentioned contemporary sustainable architecture. Similarly, sustainable urban development, in line with the idea of urban ecology, seeks to transform urban structures in accordance with the model of naturally occurring ecosystems.

10. R. Rogers, apart from the concept of sustainable architecture, also promotes a model of a sustainable city (building development project, Majorca, the building concept - Shanghai, China 1992-1994).



4. The Solar House "Heliotope", Freiburg designed by R. Disch. Photo by the author

The modern complex of the Ministry of Environment in Dessau (architect Sauerbruch Hutton, 1998-2005), as a manifesto of modern architecture open to the environment, is compared with the manifesto building - the Bauhaus school, designed by Gropius. It constituted an architectural icon and a sign at the beginning of a powerful trend in architecture, showing the way to the new period. In contrast, the contemporary architecture with glass walls and ceilings, as well as climatic glass structures of energy-efficient large-space projects, using passive and active solar energy (e.g. Eden Project, N. Grimshaw & Partners, St. Austell, England, 2001) could be regarded as the implementation and continuation of modernist dreams of the leading architect of the 1920s, B. Taut, as well as Fuller's idea. M. van der Rohe's German Pavilion in Barcelona, as the prototype of a novel understanding of space and smooth relations between architecture and nature, is compared with the Skywood House in Denham in Great Britain, designed by G. Phillips (2000). The Tugendhat Villa in Brno (1930) by the same architect, is compared with the experimental zero-energy R 128 house built in Stuttgart (2001). The Törten housing estate in Dessau, designed by W. Gropius (1926-1928), a future concept of combining the idea of a garden city with innovative housing estates, erected with prefabricated elements, is compared with the modern technology of the solar housing estate in Freiburg (2000) designed by R. Disch (Fig. 3 and 4).