



Robert Mazur*

Ecological and energy efficient architecture as a new trend in the architectural culture

Climate change at the turn of the 20th and 21st centuries is indisputable. In 1988, two Organizations of the United Nations – the World Meteorological Organization (WMO)¹ and the United Nations Environment Programme (UNEP)² created the Intergovernmental Panel on Climate Change (IPCC)³. IPCC is a permanent forum of cooperation of hundreds of scientists from many countries, publishing every few years the reports which greatly affect the development of national and international climate programs and the policy of financing research on climate change. The first report of IPCC was published in 1990, next ones in 1995 and 2001 and the last one in 2007. The last report was developed by over 600 authors from 40 countries, reviewed by over 620 experts and rep-

resentatives of governments. The summary of the report was accepted by representatives of 113 countries. The key conclusions of the Fourth Assessment Report of the IPCC (AR4) are as follows:

- Warming of the climate system is unequivocal,
- The probability that this is caused by natural climatic processes alone is less than 5%,
- The probability that this is caused by anthropogenic (human) greenhouse gas concentration is >90%,
- During the 21st century world temperature could rise by between 1.8 and 4 °C. However, the possible rise ranges from 1.1 to 6.4 °C,
- Sea levels will probably rise by 28 to 42 cm,
- There is a confidence level >90% that there will be an increase in heat waves and heavy rainfall.

In architecture the first ideas to save energy and construct environmentally friendly buildings appeared during the fuel crisis of the 1970s. A growing interest in new, non-conventional sources and technologies of energy generation has resulted in the development of philosophy of architecture which is friendly both to people and environment where it is located as well as the doctrines of sustainable development of architecture. *Currently sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs, is possible* – this famous sentence from the 1987 WCED report – “Our Common Future” (Brundtland Report – after the last name of Gro Harlem Brundtland – the Chair of the commission) set a new direction in the development of architecture at the end of the 20th century. The beginning of the 21st century strongly confirmed the ecological and energy efficient architecture as a canon and indicator of culture in creating human life space. Taking into account the precisely assigned objective of the European Commission to shift to an energy efficient and low carbon economy already in 2020 (reduction of the demand for energy by 20% and reduction of emission of CO₂ by 20% as well as

* West Pomeranian University of Technology, Szczecin, Faculty of Civil Engineering and Architecture, Division of Contemporary Architecture, Theory and Methodology of Design.

¹ The World Meteorological Organization (WMO) – international organization with 188 member states which originated from the International Meteorological Organization (IMO), which was founded in 1873. Established 1951, WMO became a specialized agency of the UNO whose task is to unify, improve and exchange of publications on meteorology as well as support studies of climate, geography, and hydrology.

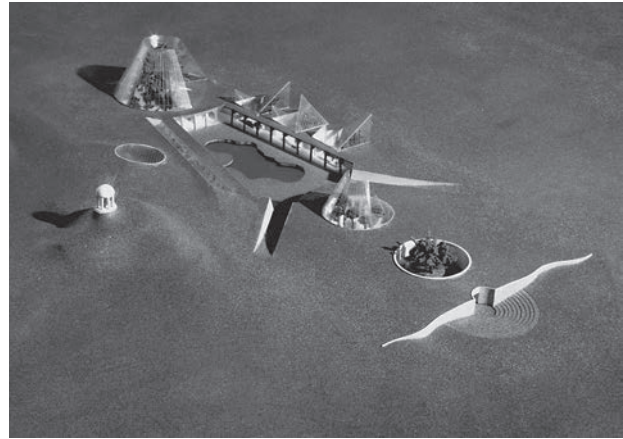
Source: http://pl.wikipedia.org/wiki/Światowa_Organizacja_Meteorologiczna.

² The United Nations Environment Programme (UNEP) – agency of the UNO established by the resolution of the General Assembly of the UNO no. 2997 from Dec. 1972 to coordinate UN environmental activities, constantly monitoring the global environment. UNEP is based in Nairobi, capital of Kenya. Achim Steiner from Germany is the Executive Director of UNEP.

Source: http://pl.wikipedia.org/wiki/Program_Środowiskowy_Organizacji_Narodów_Zjednoczonych.

³ Intergovernmental Panel on Climate Change (IPCC) – organization established in 1988 by two organizations of the United Nations – World Meteorological Organization (WMO) and The United Nations Environment Programme (UNEP) to assess the risk of climate change caused by human activity.

Source: http://pl.wikipedia.org/wiki/Intergovernmental_Panel_on_Climate_Change.



Figs. 1, 2. Lucille Halsell Conservatory, San Antonio, Texas, Emilio Ambasz – source: <http://www.flickr.com>

an increase in use of renewable energy by 20%), the following question arises: *Is ecological and energy efficient architecture only a fashion or temporary trend caused by the problems with global natural resources or architectural culture growing from the receptivity to the ideas of eco-philosophy and care for future generations as a vision of the future?* The analysis of the conception as well as of the execution of architectural designs from the turn of the 20th and 21st centuries in Europe and globally can provide the answer to that question.

Since the 1970s, the works by Emilio Ambasz have been permanently in the center discourses about ecological architecture⁴ due to their incorporation into surrounding landscape and vegetation. His works are a perfect example of the integration with nature – the key postulate of ecological architecture. The theories developed by Emilio Ambasz include the basic criteria of ecological architecture – relation to context, creative approach to landscape, symbols, ecological technologies and visionary imagination. In his designs Ambasz treats landscape as integral part of an object and, just like other architects, incorporating a human dwelling place into the context of nature, he makes references to the achievements of Frank Lloyd Wright. Schlumberger Research Laboratories in Austin, Texas, is a center of technology whose interiors, according to the assumptions of its investors, were to adapt to the changing number of its employees [3]. The location of the buildings was to be associated with data flowing through the computer and that is why the whole compound was designed as integrated with the landscape with its individual buildings buttressed with earth berms. Ambasz achieved two goals: integration with the surroundings and a better thermal insulation of the buildings regardless of the season by covering the buildings with masses of earth.

⁴ Ecological architecture – although the idea of energy efficient and environmentally friendly architecture has always been embraced by utopian architects, it became especially popular and important in the early 1970s, and particularly after the fuel crisis in 1973. London's Ecological House by Graham Caine is the flagship building of this type. Some of the most spectacular examples of ecological architecture, although never executed, include the arboreal designs by Magdalena Abakanowicz from 1991.

Source: <http://www.artinfo.pl>.

Furthermore, the design displays cosmological relations with ancient Celtic buildings and at the same time indicates the connection between the computer age communication techniques and art of earth as well as ancient rituals. Another example of work by Emilio Ambasz where earth berms are used to incorporate the building into the landscape is Lucille Halsell Conservatory in San Antonio, Texas (see Figs. 1 and 2).

The buildings with specimens of plants resemble the Hanging Gardens of Babilon. The design is crowned with forms resembling glass pyramids surrounded by furrows in the ground and moulds. This makes it look like a living monument in honor of plants, earth, and sky. The whole design provides for proper sun exposure, microclimate and exchange of air for the plants kept inside. The biggest design by Emilio Ambasz is ACROS Building in Fukuoka, Japan completed in April 1995. This is one of the most significant examples of architecture – the garden design is in opposition to garden architecture interpreted as “return to nature” associated with a house built in the natural environment. ACROS Building expresses the ecological desire to give back to nature the space taken by people and to rebuild the natural environment destroyed in the 20th century. The use of the green facade of the center of culture as an extension of the nearby parkland is no longer a visual object and it becomes an icon of architecture absorbing and stimulating senses. This design refers to the important issue for architecture ecological namely the man-made nature as opposed to original nature. This is also an answer to the question: *What is green architecture at the turn of the 20th and 21st centuries?*

The Pit by Peter Noever can be a European example of pro-ecological architecture, expressing the vision of architecture regarded as an extension of landscape [3]. The architect remodeled an old wine cellar abandoned for over two hundred years and a nearby quarry located in Breitenbrunn, Austria. This is a special combination of integrated environment, public space and landscape architecture, creating green architecture provoking further work on ecological apartments of the future. Another example of architecture integrated with the natural environment is EFA – a radio satellite station by Gustav Peichl in Aflenz,

Austria [3]. The design integrating the broadcasting station technical facilities with residential buildings into an earth slope refers to the works by Emilio Ambasz and his green architecture designs.

These examples of ecological architecture at the end of the 20th century are set in the context of the idea of integration of a man-made space with the natural space. They provide the answer to the question asked earlier: *What is ecological architecture?* The sensitivity of architects expressed in those examples and the consequence of the idea of integration of architecture with its surroundings is the best confirmation of the high culture in creating a man-made environment. The respect for green natural resources by giving back the space taken by man is an expression of a deep concern for the environment of the future generation and realization of the vision of contemporary architecture. It is worth noting that the examples do not apply modern energy efficient solutions or use renewable sources of energy. Their focus is more on design solutions and implementation of the idea of earth-oriented ecological architecture.

Ecological architecture of the 21st century is totally different. Its characteristic features include a rapid development of information technologies and technological achievements in the scope of use of renewable sources of energy. In order to meet the current needs of the society ecological architecture sets a new direction in creating human life space. Physalia – which in Latin means jellyfish – is a giant cnidarian driven by hydro-turbines designed by Vincent Callebaut covered with plants and solar panels (see Fig. 3) [1].

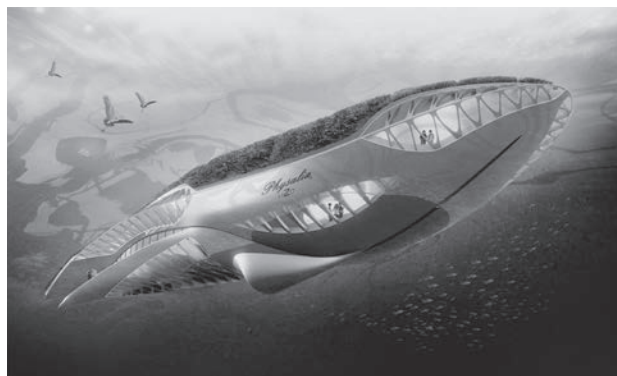


Fig. 3. Physalia, Vincent Callebaut
– source: <http://portal.architekturakrajobrazu.info>

Physalia is meant to navigate through the rivers and clean water. Furthermore, inside there will be lecture halls and gardens where the visitors will live pro-ecologically. Another design by Vincent Callebaut called Dragonfly is a vertical farm providing healthy and ecological food. The program includes the production of high quality vegetables and fruits. The futuristic ecological farm without pesticides will be located in the heart of New York. Anti-Smog is a project for one of industrial districts in Paris (see Fig. 4) [1]. A structure whose surface is coated in titanium dioxide will efficiently reduce the amount of



Fig. 4. Anti-Smog, Paris, Vincent Callebaut
– source: <http://portal.architecturakrajobrazu.info>

smog in the air. Modern architecture is supposed to be not only energetically self sufficient but also contribute to removing toxic pollutants from the air, cleaning water in nearby reservoirs or using rainwater for technical purposes.

The architect calls his work an “organic parasite” placed in a post-industrial environment full of both still operating and already abandoned factories. It will consist of two main parts. The “Solar Drop” perched over an unused railroad tracks on de l’Ourcq canal – an elliptical structure resembling rugby ball which, in compliance with the requirements of ecological architecture, will have hundreds of photovoltaic panels supplying necessary energy and systems to collect rainwater which can be used e.g. to flush toilets or clean photocells. What is, however, truly distinctive about the project by the Belgian designer is its exterior coated in titanium dioxide which, according to the author, will reduce the level of airborne pollutants and contaminants. In its reaction with smog it will break down organics and consequently clean the atmosphere. Inside the “drop” there will be public spaces and a huge exhibition hall – everything designed around a central garden full of vegetation. The other building in the ecological compound is a 45 m tall “Wind Tower” with an art gallery and a skytop garden with a spiral path leading to it. The name of the building derives from the name of special vertical axis wind turbines used in its construction that operate like the Darrieus wind turbine⁵. The Tower will be covered with LED screens to display news. Inspired by the shape of a water lily, Vincent Callebaut designed the Lilypad – a completely self-sufficient floating eco-city. This visionary urban agglomeration will be adapted to meet the need of contemporary civilization. It will have apartments, gardens, shopping centers, places for recreation and entertainment. The project is a vision of an ecological city of the future. Born in 1977 in Belgium, Vincent Callebaut expresses in his projects the ideas of ecological human life spaces needed by the 21st century information society. This is also expressed by the Perfumed Jungle as a reminiscence of jungle located in the

⁵ The Darrieus turbine – sometime called an *eggbeater* is one of two main types of vertical axis wind turbines (VAWT). Patented by Georges Darrieus in 1931.

Source: http://pl.wikipedia.org/wiki/Turbina_Darrieusa



Fig. 5. Eco Boulevard, Ecosistema Urbano – source: <http://www.plataformaarquitectura.cl>



Fig. 6. Penang Peaks, Michael Sorkin, Makoto Okazaki, B. Degn, Y. Koda
– source: <http://sorkinstudio.net/PenangPeaks.htm>

harbor. The project implements the assumption of green areas provided to the residents of Hong Kong for recreation, relax and entertainment. It may also house offices and other facilities.

Architects from Ecosistema Urbano created a project of an ecological urban space. The designers of Eco Boulevard, in Valdecañas, a suburb of Madrid, assumed that it would serve two purposes: an ecological filter and a place to stimulate social activity. They deliberately chose the form of an open pavilion that can be freely used by the residents of Valdecañas (see Fig. 5) [1]. It also serves as a city amphitheater to hold concerts and performances as well as a meeting place for the residents of the district.

Eco Boulevard is a self-sufficient structure fitted with photovoltaic fuel cells. On individual floors there are potted plants to filter the air in the district. The most interesting effect was created inside the pavilion where the air temperature is lower than outside by 8 to 10°C.

Architecture of the 21st century evidently evolves in the direction of ecological ideas, maintaining modern appearance and application of the latest technologies. This is confirmed by Rafflesia Zero Energy House from Kuala Lumpur in Malaysia, Zoki Zoli or Elm Park in Dublin, Ireland designed by Bucholz McEvoy Architects and California Academy of Sciences in San Francisco. Global solutions for cities such as Penang Peaks in Malaysia by Michael Sorkin Studio (see Fig. 6) or Shenzhen Logistic City in China, by JDS-Julien de Smedt architects are more and more popular [2].

It is impossible to describe all examples which would provide the answer to the question asked earlier: *Is ecological and energy efficient architecture only a fashion or temporary trend caused by the problems with global natural resources or architectural culture growing from the receptivity to the ideas of eco-philosophy and care for future generations as a vision of the future?* One can conclude that although contemporary architecture is a deliberate direction inspired by the ideas of eco-philosophy, however, it still applies the latest information technologies and technical solutions. The examples of projects presented above as well as architectural concepts define the vision of the future, respecting the context of the place and the natural environment as well as show deep ecological concern for future generations.

References

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***Architektura ekologiczna i energooszczędna
nowym kierunkiem kultury architektonicznej***

Przedmiotem artykułu jest architektura ekologiczna i energooszczędna jako odpowiedź na wzrastające zapotrzebowanie i tendencje w nowoczesnej wizji architektury. Kreowanie architektury przy użyciu odpowiednich materiałów oraz stosowanie zintegrowanych systemów

energooszczędnych z wykorzystaniem odnawialnych źródeł energii staje się nowym zjawiskiem kulturowym. Artykuł podaje przykłady ekokultury architektonicznej i odpowiada na pytanie czy jest to moda obecnych czasów, czy powszechny kierunek kultury architektonicznej.

Keywords: ecological and energy efficient architecture

Słowa kluczowe: architektura ekologiczna i energooszczędna