Bioclimatic Architecture

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Abstract: The aim of this paper is to discuss the idea of bioclimatic architecture from its genesis to the presentation of the most advanced contemporary examples. Different ways of adapting dwelling to the climate are compared and analyzed. The basic solutions are commonly found in vernacular building. Some modifications and improvements can be also observed while particular methods differ depending on the regional traditions, available materials, developed techniques etc. Today, with the application of cutting-edge technology, bioclimatic building is based on much more advanced systems, both passive and active. Also the respect towards nature is declared by most of the architects. However, in many cases a more detailed investigation reveals the lack of understanding of the complexity and fragileness of the existing ecosystems. So called green or sustainable buildings, although constructed from renewable materials and even awarded with energy certificates, are often designed without proper analysis of the specifics of local environment, neither natural nor cultural. The opportunities created by the building location, especially in terms of occurring bioclimatic conditions are usually ignored. The author of this paper describes how indigenous climatic solutions from vernacular building evolve from simple to more complex systems and how they are smartly combined with the newest technology to create mature and conscious bioclimatic architecture. Two presented case studies are some of the best examples illustrating how the concept of bioclimatic architecture works in practice and what opportunities are created by that.

Key words: Bioclimatic architecture, clean environment, passive cooling, energy efficiency, environmental passive and active strategies, sustainable building, climate responsive facade.

1. Introduction

The aim of this paper is to explain and discuss the idea of bioclimatic architecture as one of the most actual and important phenomena in contemporary building [1, 2]. Although the necessity to develop the built environment with the respect towards nature is commonly declared [3, 4], most of edifices are still erected without proper understanding of bioclimatic design. In purpose to make this complex issue more clear both to the architects and to the building users, the author of the paper presents the formative process and evolution of bioclimatic architecture from its genesis to the most advanced contemporary examples. Therefore, the paper describes how indigenous climatic solutions from vernacular building [5, 6] evolve from simple to more complex systems and how they are smartly combined with the newest technology to create mature and conscious bioclimatic architecture. Different ways of adapting dwelling to the climate are compared and analyzed.

The paper is based on the analysis of two case studies, which are some of the best examples illustrating how the concept of bioclimatic architecture works in practice and what opportunities are created by that [7]. This analysis is used as an exemplification how the authors of presented buildings take advantage of specifics of local climate and natural environment. The effective application of clean energy combined with proper understanding of complexity and fragileness of the existing ecosystems is another distinguishing feature of the chosen case studies [8, 9]. These issues are extremely important, especially in the light of accelerating climate changes, which compel to
undertake actions that would lead to the immediate reduction of global warming potential as well as to more conscious exploitation of Earth’s resources. Applied solutions are described also in terms of their vernacular origins which are new approach to the topic proposed by the author of this text.

2. The Concept of Bioclimatic Architecture

The first rule of bioclimatic architecture is to take advantage of local bioclimatic conditions with the benefit of the natural and built environment. That approach should always be based on multidisciplinary in-depth research of individual circumstances: from the specifics of the ecosystem through cultural factors up to the economic analysis. In final effect safe and comfortable building which is created does not harm the environment but contributes to its health and enriched biodiversity.

2.1 User Comfort in Bioclimatic Building

To satisfy contemporary anticipations the built environment needs to ensure suitable temperature range, adequate humidity and air exchange, good acoustic parameters as well as correctly designed lighting. Overall visual comfort expectations should be also met. In numerous cases these are lighting and indoor climate requirements that tend to bring about some serious issues [10, 11]. In standard buildings, in spite of many criticism, the plant air conditioning systems are most frequently used in purpose to regulate temperature and humidity [11]. However, in bioclimatic premises the application of renewable materials and energy sources is promoted, while the usage of plant systems is considerably reduced in favor of methods described further in the text.

One of the key elements of proper bioclimatic design is maximum usage of daylight to ensure adequate illumination of interiors. Reduction, or in some cases even elimination of electricity consumption for artificial lighting, leads to significant savings, both for the consumers and the environment. Natural lighting should be carefully controlled to avoid glare effect and overheating, but correctly designed, is an important factor of the user comfort. Finally, appropriate daylighting has positive influence on the human perception of the built environment, which should not be underestimated.

Thermal comfort in bioclimatic buildings can be achieved in many ways. Some of the most efficient systems are based on radiating floors and ceilings. Unlike high-tech edifices in eighties and nineties years of XX century which were operating in the narrow range of so-called optimal temperature and humidity parameters, bioclimatic structures allow for some customization and more individual adjustment of thermal settings. The most advanced and simultaneously the most economical solutions are hybrid systems, which examples will be presented in the following part of the paper.

Correct oxygen content is another necessary factor of the comfortable indoor microclimate. This parameter is often underestimated, which should not happen as the permanent lack of oxygen in rooms where people spend a couple of hours a day may result with symptoms like drowsiness, tiredness, delayed responsiveness and less effective functioning of the brain. Prolonged exposure to hypoxic conditions may also lead to some pathological changes in human organism, particularly at the level of the body's biochemistry [12]. Therefore the amount of oxygen in the built environment should be carefully controlled. However, the level of oxygen in the building interiors can be relatively easily increased by properly designed ventilation as well as by the introduction of greater amount of green plants into the edifice. Some very interesting examples of how such systems work in practice can be observed in already existing regional architecture. Analysis of traditional solutions that were used in purpose to provide the building adaptation to the climate helps to choose some everlasting methods but also to develop new bioclimatic strategies.
2.2 Lessons from Vernacular Architecture: Passive Cooling and Heating

Observation of vernacular dwellings continuously brings about the opportunity to “study the application of passive techniques […] that are integral constituents of the buildings’ architecture and the inhabitants’ lifestyle” [5]. In hot climate the most obvious factor of the building adaptation to the local conditions is the efficient cooling, which is usually based on natural ventilation and the use of water. Overhanging roofs, louvers, trees or other shading elements help to reduce thermal load of the façade. Thermal massing as well as various insulation systems are also used in hot regions to protect against overheating during the day and gradually release the stored heat during the night. Among passive cooling systems based on natural ventilation and commonly applied in different parts of the world 3 basic methods can be distinguished [13]:

1. Cross ventilation based on the pressure difference across the building (Fig. 1a);

2. Chimney ventilation based on the stack effect i.e. underpressure caused by the rising hot air (Fig. 1b);

3. Wind towers and wind catchers based on overpressure and underpressure (Fig. 1c).

On the basis of these three simplest solution some local modifications were developed:

1. Cross ventilation combined with elevated floor and cooling radiation from the ground in hot and humid regions (Fig. 2) [14, 15];

2. Cross ventilation combined with stilts and evaporating cooling from the water surface in hot and humid regions located near water reservoirs (Fig. 3);

3. Chimney ventilation combined with passive evaporating cooling in hot and dry regions (Fig. 4) [6].

The sad fact is that regardless all the natural cooling techniques developed in the past, today plant air conditioning systems are widespread worldwide and commonly used both in private and in public spaces, especially in offices, shops, administration and transportation facilities etc. These methods are not only expensive and consuming large amounts of electricity but also have negative impact both on human health and the environment.

In colder regions proper natural ventilation and effective cooling during warm summer days are also important but some other issues are in the center of attention. These are connected with heating, especially during the cold period of the year. The main passive strategies that are traditionally used in purpose to provide indoor thermal comfort in temperate and colder climate zones are thermal massing and...
sufficient insulation (Fig. 5). That results with thick, massive walls, roofs and floors. These elements store heat during the day and release it during the night.

In the northern hemisphere the number of openings in the northern side of the building is reduced. Only small windows are located in well insulated northern façade to provide some daylighting while avoiding the heat lost.

Big glazed openings are usually situated on the southern part of a dwelling to allow for passive solar heating in winter which contributes to significant energy savings. The same solution affects positively the interiors insolation during winter, which is a critical issue for the user well-being at temperate and higher latitudes.

Ideas developed in vernacular architecture would always vary depending on climate conditions as well as on locally available resources that influence building techniques [16]. Indigenous methods in different regions are tailored to the functional needs, habits and traditions of the inhabitants. However, in some cases, original solutions do not fulfill the expectations of modern generation of users. These are mainly connected with the need of openness to the light and space. The concept of bioclimatic architecture allows to combine cutting-edge technologies with traditional methods of dwellings adaptation to the climate. One of the crucial aspects of this phenomena is that bioclimatic approach helps to apply both passive and active strategies in the most efficient way.

2.3 Bioclimatic Approach: Integration of Infrastructures

According to Ken Yeang the whole built environment should be based on the integration of so called Eco Infrastructures, that respect the ecology on all possible levels and therefore reach beyond simple technological infrastructures [8]. Within Eco Infrastructures four groups are distinguished. The first, “Green”, is related to the complexity of ecosystems, natural habitats, environmental biodiversity, wildlife, animals and plants migrations, etc. The second group concerns “Gray” engineering systems, oriented towards sustainable energy and low environmental impact technologies as well as zero CO₂ emissions. The third group is connected to water management and recognized as “Blue”. The issue of saving pure water sources on the planet is of utmost importance and consequently harvesting rainwater as well as gray water recycling is seriously taken into account. Finally the last “Red” group concerns all the influence of human culture. That involves cultural and social norms and law regulations but also the expectations of contemporary user regarding indoor microclimate, acoustic and visual comfort, etc. An important part
that needs to be considered in that category is the human impact on the environment including proper materials selection, based on Life Cycle Assessment analysis. This method allows to assess potential impacts associated with products and processes by evaluating all phases necessary to produce, operate and dispose a building [17].

The main concept that stands behind Eco Infrastructures is the approach oriented towards constant ecosystem preservation, healing and restauration, especially concerning the matter of equilibrium and biodiversity. That holistic strategy is a distinguishing feature of bioclimatic architecture, which accentuates value of extensive studies of biological and climatic conditions and is not limited to energy certification achievement.

Due to the level of complexity, the concept of bioclimatic architecture may seem a bit utopian. Nevertheless, with today’s knowledge and technology, we are able to implement this idea into the real buildings. These are experimental objects that allow to assess which solutions work in practice and which should be further improved. In the following part of the paper the two case studies of very advanced, already completed bioclimatic buildings are discussed. The buildings are presented in chronological order of completion date.

2.4 Case Study: Sino-Italian Ecological and Energy Efficient Building (SIEEB), 2005-2006, Beijing, China, Mario Cucinella Architects

SIEEB, which stands for Sino-Italian Ecological and Energy Efficient Building in Beijing (China), was designed by Mario Cucinella Architects (MCA) together with Politecnico di Milano and completed in 2005-2006 (Fig. 6). The edifice was erected as a join enterprise undertaken together by the Ministry for Environment and Territory of the Republic of Italy and the Ministry of Science and Technology of the People’s Republic of China “to develop bilateral long-term cooperation between the two countries in the fields of energy and the environment and is a showcase for the potential for reducing CO\textsubscript{2} emissions in the building sector in China” [18].

The building is located within the Tsinghua University Campus in Beijing. SIEEB is the seat of Sino-Italian, research and education center for environmental protection and energy conservation. It is situated on the plot 60 \times 60 meters, it is 40 meters high and provides 20.000 m\textsuperscript{2} of floor area. The edifice houses offices, lecture rooms, auditorium with 200 seats and recreational green zones.

Architectural concept of SIEEB is based on the studies of local climate conditions including sun angle in summer and winter, dominating wind directions, temperature and humidity. Computer simulations were carried out in purpose to assess the building performance in dependence to its orientation, shape, structure, envelope etc. Also various technological solutions were analyzed to provide an equilibrium between expected energy efficiency, functional demands, indoor comfort and esthetics. Lowest environmental impact and especially minimum CO\textsubscript{2} emissions were of utmost importance. The authors of the project compare the SIEEB to the leaf, as “[…] the building uses and transforms solar light into energy” [19]. In fact the combination of passive and active strategies, controlled by the Building Management System (BMS), allowed for the optimization of the
building performance with the minimal energy consumption (Fig. 7).

Following the research results SIEEB was designed as a U-shaped structure, maximally opened to the south and protected from the north. The whole idea was oriented towards reduction of energy demands for cooling in summer and heating in winter. Southern façade has pilled-up, openwork form to provide air and sunlight penetration into the internal areas of the edifice. Glazed elevation is shaded by cantilevered structural elements, extended to the south to prevent excessive solar radiation (Fig. 8). Additional protection is achieved by properly chosen angle of photovoltaic panels as well as by deciduous plants overheating from the upper floors. Thus obtained shaded terraces offer attractive green spaces for the building users. However, the most pleasant recreational areas are situated in the central courtyard at the base of the building. Especially designed landscape is composed of multilevel gardens and water ponds. Rainwater collected on the roof is stored in rainwater tank below the ground level, treated in water recovery unit and used for irrigation as well as for supply ponds and water cascades. Evaporating water combined with cross ventilation provide excellent ambient cooling. Chimney effect supports natural ventilation while green plants contribute to increase the amount of oxygen in the air (Fig. 9). According to the authors these terraces, gardens and creeper plants dispersed around the building are important distinctive features of the project [18].

![Fig. 7 SIEEB, 2005-2006, Tsingua University, Beijing, China. Designed by Mario Cucinella Architects, environmental strategies, winter. © MCA Archive.](image1)

![Fig. 8 SIEEB, 2005-2006, Tsingua University, Beijing, China. Designed by Mario Cucinella Architects, southern façade detail. © MCA Archive.](image2)

![Fig. 9 SIEEB, 2005-2006, Tsingua University, Beijing, China. Mario Cucinella Architects, ambient cooling in atrium. Photo: Daniele Domenicali © MCA Archive.](image3)

Unlike the southern open part of SIEEB, the northern façade is opaque, well insulated and protected against cold and strong winter winds, which are typical for Beijing. Under the blue colored curtain wall there are thick insulating panels. Double glazed windows provide very low heat transfer coefficient value $U=1.4 \text{ W m}^{-2} \text{ K}^{-1}$. The only opening in this north-oriented protective shell is the main entrance from the campus and the green corridor situated at the bottom of the building which allow for effective cross ventilation in summer through the gardens located under the structure.
Eastern and western double skin façades are designed to optimize the amount of daylight in the internal offices. Blue curtain walls form a geometric composition of opaque and transparent modules. Double glazed back enameled panels create the background for external silk-screen façade. Silk-screen glass panels are covered with unobtrusive linear pattern, which not only gives the building a modern and elegant appearance but also helps to prevent glare and provide advantageous penetration of light. Other components of light management system are internal roller blinds and external light-shelves, followed by internal aluminum light shelves. These elements allow for solar radiation control as well as for sunlight filtration and distribution.

The inner curtain wall system around the internal courtyard is equipped with horizontal external glass louvers of different angles to control the insolation and solar gain (Fig. 10).

Integrated cogeneration system within the building allows for simultaneous generation of heat and electricity. The system consists of PV panels, cogenerator, boiler, absorption heat pump and chiller. Efficient cooling and heating of interiors is possible with radiant ceilings.

SIEEB functions are divided into two groups. The first group is accessible for public and consists of main hall, exhibition halls and big auditorium. These spaces are situated at the lower part of the edifice, i.e. below the street level, on the ground floor and on the first floor. The common areas in the building are related to the internal gardens and green terraces. The access is possible thorough the northern entrance and the pedestrian walkway leads to the open southern part. The second part is dedicated to offices and laboratories, positioned on upper floors with more limited admittance. Vertical communication within the building was arranged in two main blocks with lifts and staircases situated in eastern and western wings.

Although the building is symmetrical, there is no impression of rigorous geometry due to irregularly shaped terraces and ramps, broken axes of pedestrian crossing, composition of ponds and waterfalls and finally the richness of plant cover that create different environments and perspectives in public areas. Altogether these elements make the bioclimatic building character visible and understandable.

2.5 Case Study: Solaris, 2008-2010, Fusionopolis, Singapore, TR Hamzah & Yeang

Solaris Building in Singapore was designed by TR Hamzah & Yeang and completed in December 2010. The structure is composed of two towers, that comprise offices as well as research facilities. The most important determinants of the project were local climate and ecosystem. Detailed and multileveled research on environmental factors including sun-path, humidity, temperature, wind direction but also the biodiversity were carried out as a crucial part of preliminary studies. As the edifice is located in Fusionopolis, the area where former military base was situated before, the designers decided to focus on the restoration and enrichment of seriously damaged ecosystem.

The position of Solaris, which is placed very close to the equator, required the application of bioclimatic strategy with the climate-responsive façade and roof construction. The sun-path analysis resulted with the
concept of extended shading elements, among which there are white sunshade louvers, roofs and overhangs (Fig. 11). Their shape is determined directly by the east-west sun-path and they contribute to significant reduction of both solar gains and glares. However, the most spectacular motif in the whole architectural concept is the green spiral ramp on the perimeter of the building (Fig. 12).

The landscaped ramp of 1500 meters of length was designed to provide continuity of natural environment and best connection with built environment. It is 3 meters wide at its narrowest point and completed with a service path, necessary for plants maintenance. In this way TR Hamzah & Yeang created the linear park that links together One-north Park at the bottom of Solaris building and the roof gardens towers on the tops of the two towers, of which one has 9 and the other 15 floors. In the highest point the structure measures 79 meters of height and the two parts are connected by the big atrium situated between them. The ramp allows the small living organisms to roam freely within all green zones of the building. In such a way architecture does not create the barrier in the ecosystem but instead contributes to its integration and therefore also to health and greater biodiversity.

To cover maximum surface with green plants and provide huge variety of vegetation, the building corners were transformed to wider terraces, which are also used for recreation. This concept brought about the impressive ratio of 108% of total landscaped area (8,363 m²) to the site area (7,734 m²). Such amount of greenery requires large quantities of water for irrigation purposes. Because of the high average annual rainfall in Singapore and as the logical consequence of bioclimatic approach, the large-scale rainwater recycling system was implemented. It consists of the symphonic drainage on the roof and drainage downpipes on the perimeter ramp. Rainwater harvest rooftop transfer tank is situated on the top of the higher tower, while another rainwater tank is located at the basement and used as a harvested water storage. With total storage capacity of 700 m³ rainwater tanks can cover most of the irrigation demands in Solaris. Necessary organic nutrients are delivered by an integrated fertigation system. All plant fertilizers are harmless for the environment and dispersed in a way, which is not obstructive for the building occupants.

The atrium located between the two towers contributes to adequate air and daylight distribution

Fig. 11  Solaris, 2008-2010, Fusionopolis, Singapore. Designed by TR Hamzah & Yeang. The view of the building facade with the green ramp. © TR Hamzah & Yeang.

Fig. 12  Solaris, 2008-2010, Fusionopolis, Singapore. Designed by TR Hamzah & Yeang. Perimeter ramp and facade shading. © TR Hamzah & Yeang.
throughout the building (Fig. 13). In Solaris the idea of bioclimatic architecture effectively links vernacular cooling methods observed in hot and humid climate zones with contemporary technology. The atrium is fully passively cooled with the application of cross ventilation and convection. However, the air flow in atrium was analyzed with the Computational Fluid Dynamics (CFD) simulations to make sure that the system will be sufficient and will provide high thermal comfort without too fast air movement. The roof is featured with operable glass-louvered skylight controlled by climate-responsive sensors to enable stack cooling and simultaneously to protect the inner space during the rain. The same system controls the rain screen walls. Inside the atrium the idea of equilibrium between natural and cultural environment has been continued with the vegetation introduced on many levels.

The atrium with glazed walls and ceiling allow to maximize sunlight penetration into the public areas of Solaris. Another visually strong element which contributes to optimal daylighting in the offices is so called solar shaft. It crosses the structure diagonally and introduces natural light into the areas positioned in deeper sections of the edifice. Also the façade shading louvers are designed to redirect the light into the building by creating double light-shelves. The light distribution was completed with the eco-cell, located in the north-east part of the building. The role of eco-cell is to enable ventilation air supply as well as daylight penetration into the parking area. At the same time the connection between the ramp and lower sections was established, allowing for the plants extension below the ground level.

Environmental strategies applied in Solaris resulted not only with spectacular building and high level of user comfort but also with significant reductions in terms of energy consumption. System performance in the building is optimized in many ways. For example light sensors measure the illumination level and when sufficient amount of daylight is registered, the artificial lighting is switched off automatically. With

Fig. 13  Solaris, 2008-2010, Fusionopolis, Singapore. Designed by TR Hamzah & Yeang. Section presenting bioclimatic concept. © TR Hamzah & Yeang.
carefully designed façade shading and low-e double glazing, external thermal transfer value (ETTV) of the whole system is 39 W/m². The reduction in overall energy consumption in Solaris reached 36% in comparison to relevant buildings [20].

Two bioclimatic buildings: SIEEB and Solaris indicate new directions for the development of contemporary architecture and their budget allowed for some exemplary technological solutions. Both edifices are dedicated to research and education. Such examples allow for the practical application of new concepts and technologies that should lead to highest energy efficiency and to the balanced relations between human culture and natural environment. Therefore it is very important to analyze these buildings in purpose to learn and draw conclusions how to take advantage of contemporary knowledge to create architecture perfectly inscribed into local biological and climatic determinants.

3. Discussion: Vernacular versus Bioclimatic Architecture

There is a lot of similarities between vernacular and bioclimatic architecture. First of all both of the ideas are characterized by the proper adaptation of the building to the climate specifics. Second issue is the concept of living in a balance with the natural environment which is very obvious in vernacular structures and consciously created in bioclimatic edifices. Bioclimatic approach involves in-depth understanding of complexity and sensitiveness of the ecosystem. Also the respect for the cultural heritage of the place, where the building is erected can be noticed in both architectural phenomena.

However, vernacular and bioclimatic building differ a lot regarding the applied technology level. Traditional dwellings are usually based on knowledge developed in particular region of the world and transferred from one generation to another as a part of the heritage. Contemporary bioclimatic architecture combines indigenous methods with the most advanced technology. Nevertheless, the critical point in this approach is the smart combination of passive and active methods, based on multidisciplinary research (including e.g. energy efficiency, environmental impact, cost analysis etc.) and not just the affirmation of the technology itself. Finally “the main difference between vernacular and bioclimatic building lies in the ability to select the technological solution most appropriate to the climate” [7]. Consequently, bioclimatic architecture should use the most suitable traditional methods together with cutting-edge technology in purpose to achieve optimal adjustment to the local climate and to the modern user expectations. Hybrid systems and real-time modifications are applied to optimize performance of the building perceived as a whole.

The analysis of presented case studies proved that indigenous ideas, originally developed in vernacular architecture and described in the first part of the paper, formed the basis on which contemporary bioclimatic buildings were shaped. The research showed how basic passive methods and the most advanced technologies were successfully hybridized in purpose to provide high level of indoor microclimate comfort and optimal performance of the building systems. SIEEB and Solaris projects were created as a result of integrated design processes and collaboration between architects, consultants and researchers from many fields including e.g. biologists and specialists in the field of environmental protection. In both analyzed buildings holistic design, which involved not only technological, but also continuous environmental studies was strongly promoted. The research has also demonstrated that the authors of SIEEB and Solaris have seriously taken into account the individual character of the ecosystem and created the built environment in equilibrium with the natural environment. As a consequence both analyzed buildings do not impair the environment but instead enrich the ecosystem and are perfectly adapted to local natural and cultural context. The new structures
respond to climatic and biological conditions on many levels.

The research allowed for the conclusion that the crucial elements of bioclimatic strategy are: properly designed external envelope of the building, followed by climate responsive façade design. A key issue is that different solutions must be provided for different orientations of the building elements. Also the matter of air preparation and distribution throughout the building is of the utmost importance. In both edifices natural ventilation is efficient and allows for significant energy savings. In SIEEB the innovative radiant heating and cooling systems were combined with cutting-edge technologies and renewable energy. In Solaris the devastated ecosystem restoration and biodiversity enhancement were considered the main aspects of the project.

It is worth to notice that although presented edifices were experimental and pioneering in a global scale, their costs were not higher than for comparable facilities. At the same time the buildings are well adapted to their bioclimatic conditions and their impact on the environment is minimal. That leads to the conclusion that bioclimatic architecture arises from the respect for the natural environment with the proper understanding of the ecosystem complexity and on the basis of conscious, knowledge-based combination of traditional methods proven in time with the latest technological achievements. The outcome is the advanced and mature bioclimatic architecture that is not only comfortable and healthy but also leads to enriched biodiversity and sustainable development of natural and cultural environment.

4. Conclusion

The study described the idea of bioclimatic architecture from its genesis and showed how basic methods of adapting architecture to the local climate originated in vernacular building evolved from simple to more complex systems. The author of the text explained how indigenous solutions, developed in different regions of the world, gained support by the application of cutting-edge technologies and how contemporary knowledge transfer increases the awareness of the available possibilities. That allows to choose strategies most appropriate to the climate and ecosystem which is especially helpful in the regions that did not develop their own suitable vernacular examples. The research revealed how basic passive methods were successfully hybridized with the most advanced technologies to provide comfortable indoor microclimate and optimal building performance. The study explained the importance of individual analysis of biological and climatic determinants that must be carried out for each location which excludes the practice of copying some techniques and producing dwellings without complete checking their potential environmental impact. Finally the research results with the conclusion that contemporary bioclimatic architecture can be defined as one that is based on traditional systems of adapting dwellings to the climate but combines them creatively with advanced research, design and technological methods. This approach results with developing innovative systems designed specifically for the location needs. The main goal is the architectural environment, which is comfortable for the user and maximally integrated with the ecosystem in purpose to retain its natural harmony and continuity.

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References

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