Periodicals of Engineering and Natural Sciences ISSN 2303-4521
Vol. 9, No. 3, July 2021, pp.122-131

Contextual parameters of contemporary modernist house in the Mediterranean

Adnan Zoranić
Architecture Department, International University of Sarajevo, Sarajevo, Bosnia and Herzegovina

ABSTRACT

Dealing with environmental sustainability in architecture is often the presentation of technological and financial power or just a reflection of some fashionable experimentation. Contrary to such developments in architecture is the pursuit of understanding the different contextual determinations of every place on which we build. Ideas that respecting regional cultural-historical, social, climatic, topographic and other natural parameters dating from the very beginnings of the modern movement in architecture. There are especially pronounced in the area of the Mediterranean countries, in contrast to the wealthier, north and west European countries where the modern is initially impressed with machine and technology and more oriented to internationalism. Traditional Mediterranean architecture is essentially rational, with recognizable materialization and technology, formally purified and conceptually clear. Mediterranean vernacular architecture became the basis for the emergence of the Mediterranean modernism recognizable by a specific attitude towards human needs, regional characteristics, design and organization of space, respecting nature and adapting to climate factors and use of traditional material and its combination with new technologically advanced materials. Modern architecture has evolved in its development especially in its relation to the context. Neo-modern expression, especially the one present in some of the Mediterranean countries insists on a bioclimatic definition, integration with the environment and mixture of local and modern in concept, design, materialization, but primarily in understanding the essence of these relationships.

Keywords: Modern architecture, Mediterranean context, environment

Corresponding Author:

Adnan Zoranić
International University of Sarajevo
71000 Sarajevo, Bosnia
E-mail: azoranic@ius.edu.ba

1. Introduction

In the process of creating a modern residential house, it is necessary to consider and take into account the natural and built environment, climatic determinants, ecological aspect, human needs and to set these, often opposing facts, in a mutually balanced relationship. A comprehensive design approach that is based on respect of the existing and previous is the basic idea of architecture in the context. Bioclimatically oriented architecture offers one of the answers based on clear premises of architecture harmonized with nature in order to respect the environment, opposed to imposing attitude of ignoring and dominating over the environment. The development and evolution of the modernist house since the 1930s and later with prominent representatives of the architecture of critical regionalism goes in the direction of understanding the context, until nowadays when we are seeking answers to numerous environmental issues in architecture and construction. Understanding and systematizing the basic parameters of the context and environmentally oriented architecture in the Mediterranean is one of the most important features of the new modernism and as such should be considered with other features of the new modernist architecture.

2. Tradition

Tradition in architecture is a strong feature of some particular area based on cultural-historical, religious and ethnographic specifics. The Mediterranean is a vast treasure of world heritage because of the size, number, value, diversity and influence of the civilizations that emerged, lasted and alternated in this part of the world. In

architecture, this layering is manifested through the existence of different styles and their permeation, through the existence of architectural innovations and the use of characteristic materials. All these stylistic expressions are taken as autochthonous with certain variations caused by natural, religious or cultural conditions [1]. In addition to these achievements of civilization, there is something in the "ordinary", vernacular, "folk" architecture and experience of this area. "The traditional notion of Mediterranean living is suffused with simplicity, an openness to landscape and the sea, and with that particular erosion of divisions between indoor and outdoor space, as well as an emphasis on texture, organic and sea-blown colors, and solid, natural materials [2]." Proper understanding of tradition in contemporary architecture implies reinterpretation, but never copying, implies a comprehension of the essence and philosophy of autochthonous, traditional construction; so opposed to the repetition of historical stylistic elements from previous times.

3. The social context and needs of contemporary man

"Life on the shores of the Mediterranean is depicted as a great sensual experience of happiness, the vital stimulus being attributed to the three gods of the Mediterranean: The sun, the sea, the sky. It is what the French call the *pensee midi* which literally means „meridian thinking". But it encompasses so much more. It is the Mediterranean philosophy of harmony and measure, of oneness with nature, of Southern light as the source of thinking, of the appeal to measure as the center of existence, of the inner stability of the Mediterranean world as the cradle of form, together with an exuberant homage to the culture of Greek Antiquity and Italian Renaissance, the philosophy behind the vital spirit of the classical era and its heritage [3]."

This romantic and an idealized view of the habits and life philosophy of the inhabitants of the Mediterranean can form the basis for understanding the social and cultural context in this area. Socio-political, cultural-traditional, religious and ethnic diversity represents the richness and complexity of the Mediterranean. Contextual thinking aims to look at all the perceived aspects of the impact for the emergence and existence of successful architecture. Man as a social being must be treated as a member of the community in which she or he lives, integrated into its life, and in accordance to her or his own needs, interests and habits. Her or his house should be built based on such premises. Although the needs of modern man can be subsumed under a number of similar requirements, traditional, cultural, and religious reminiscence will form a substantially different basis for designing a man's home in Syria, Tuscany or Greece. It can be said that the area of the northern or European side of Mediterranean is the largest more or less compact space with a similar socio-political context which has a similar cultural and historical background, while other parts have some wise different social environment [1].

4. Bioclimatically oriented architecture in the Mediterranean

An approach to architecture that is adapted to nature and the place has a strong foundation in history when a man was directly dependent on climatic and environmental factors and on resources from the immediate environment. During the twentieth century, due to strong technological advances and pronounced alienation from nature, human civilization lost awareness of the need to preserve the environment and the disposable resources. World population growth, enormous consumption of natural resources, production of waste materials and their inappropriate disposal, deforestation, less and less fertile land and greenhouse gas emissions are just some of the manifestations that are destroying the planet on which we live. Arrogant attitude towards the environment has resulted in a number of environmental problems, culminating in increasingly intense and noticeable climate changes. There is a growing awareness that human civilization cannot survive without radical change and a strong orientation towards ecologically sustainable systems. Such an approach in architecture will inevitably bring us back to the search for solutions known in the past from which we should use the experiences, methods and materials of ancient builders and reinterpret them by using scientific knowledge and technological advances, adapting them to the needs of modern man and fully in harmony with nature. By recognizing the quality of traditional methods in construction and rediscovering the principles of bioclimatic architecture, the context in architecture has gained a comprehensive expression that will not only treat the immediate, usually

only the built environment, but will take into account a number of factors relevant to the wider community. An ecological conscious approach to design will aim to reduce the environmental impact of the newly built facility, it will seek to reduce energy and water consumption, and the production of energy from renewable sources will take a significant share.

Observing the autochthonous architecture in the Mediterranean, we will recognize that it was created in the spirit of adaption to the climatic and environmental conditions of the area. It was materialized with easily accessible material, in a way that could provide the comfort of staying in different weather conditions and seasons. The Mediterranean vernacular architecture was often created from stone material extracted and collected from the surrounding, in order to obtain larger arable land. Essentially, a house arises from the area in which it is built, serves its builders and owners, and finally, decaying and returns to that same space [1].

According to Filip Šrajer, the indigenous Mediterranean house is biodegradable and recyclable, and it emerges and disappears through eight different phases:

- site selection, clearing of vegetation
- preparation of terrain and materials for construction
- masonry walls
- roof works
- use of the house - smoke and soot impregnate the wood against pests, rot and fire
- cessation of use of the house (lighting a fire) - parasites settle in wooden beams
- shortly after the man, the house dies: the roof collapses, the vegetation begins to destroy the walls
- biodegradation and recycling: the remains of the house are slowly disappearing under vegetation and atmospherics, and due to the soft binder, better quality stones together with the cover are easy to be reused [1].

Ecological, green, sustainable ... architecture are just some of the current names that describe the action course based on ecological principles. In systematizing the principles of environmentally sustainable design in the Mediterranean, it is necessary to take into account the most important:

- location, position, orientation and spatial organization of the facility,
- size and shape of the object - harmonized with the real needs of users,
- thermal characteristics of the building envelope - adapted to warm summers, a large number of sunny hours, and humid and windy winters,
- energy - great opportunities for the use of solar and wind energy, a combination of different parameters to reduce the consumption of heating, cooling, lighting and electrical appliances,
- water management - rainwater use and rational consumption of drinking water,
- technological improvements - aimed at reducing consumption and increasing energy efficiency,
- greenery - used for centuries as shade and protection from the wind [4].

An ecological approach to design with accordance to the above stated principles is imperative in modern architectural practice.

5. Basic principles of ecologically efficient residential architecture

By the end of the 19th century, two key tasks of architecture, realized with classical materials as stone, wood and brick, were to ensure physiological comfort for man and to meet the requirements of an aesthetic nature. Tasks were not in serious conflict until the end of the 19th and the beginning of the 20th century, when architecture was marked by new materials - reinforced concrete, steel and glass. Their mechanical and aesthetic properties provided architecture with new, great constructive-spatial and aesthetic possibilities. Architecture was experiencing perhaps the greatest turning point in its history; except for the work of a several architects,

modernism generally meant the greatest distance from the principles of bioclimatic architecture [5]. Problems arising from this approach have pointed to the need of searching for roads whose starting point is establishing architecture adapted to man and nature. Intensive use and enormous consumption of different types of energy in the 20th century and the constant increasing of energy prices have triggered the first reflections on savings and how to reduce consumption in buildings. The invention and use of insulation materials in construction has resulted in a significant improvement in the physical characteristics of buildings. Architectural physics is an established scientific discipline that has enabled us to create energy efficient buildings and to determine the development of new and improved characteristics of traditional building materials. Increasing pollution of the natural environment, depletion of resources, population growth and obvious climate changes have put environmental issues at the center of global interest. It can be said that awareness and the need for environmentally responsible behavior has brought changes in the direction of architecture development. It is a known fact that the building sector leads in CO2 emissions with over than 40% of total world emissions ahead of transport and industry. However, the problem of ecological construction not only treats reduced energy consumption, but also treats other elements of importance for the protection of the human environment. In order to define energy-efficient residential architecture, it is necessary to systematize the elements and basic principles that affect the design and construction of modern, environmentally friendly buildings.

5.1. Location, position, orientation, spatial organization

Architecture based on respect for the natural environment in which it is created with the desire to be integrated to climatic and environmental conditions, as opposed to aggression and imposition, will be always a good basis and starting point for design that will prevent the occurrence of irreparable failures. The built site should be the starting point which will define the design, orientation and spatial organization of the building. The building blended into its natural and architectural environment is a prerequisite for meeting other important principles of sustainable building. Architecture in the context must meet aesthetic requirements and adapt its design to existing cultural-historical, traditional, topographical, vegetation and climatic determinations. By orientation of the building is necessary to take into consideration the need for optimal sunlight and lighting. This need will vary in different seasons and parts of the world, and it is necessary to anticipate and search for innovative and flexible solutions. The spatial organization, layout and size of the openings should enable the positive effect of the sun's rays, but also provide protection from the sun when the sun does not suit us. Many solutions applied in the traditional architecture of the Mediterranean, completely appropriate to modern man, and successfully optimized the stay in the space of the house. “In the traditional architecture the mechanism of indoor thermal regulation was incorporated in the building. The topography, the construction, the morphology, even the layout and use of internal spaces participated in the operation and function of the thermal regulating mechanism [6].” Such solutions reduce the dependence on the use of technological support that significantly increasing energy consumption, which are prone to failures and depend on a continuous energy supply. The local climatic characteristics of a particular site need to be carefully analyzed in order to lead to an inventive architecture that meets the rational, bioclimatic requirements. The result of such approach can be architecture that is more the outcome of creativity and designer’s architectural skills, and that relies less on expensive highly sophisticated, but also wasteful technology. Widespread type of traditional house in the Mediterranean meant a house with an inner courtyard, which perfectly suits the climatic conditions. It has shady spaces for protection from the hot summer sun, but also solariums for the accumulation of precious winter sun. The closed structure protected against the cold winter winds, but also allowed ventilation in the summer heat. Structure of the traditional house of the Mediterranean corresponded to the cultural and sociological requirements and often desire to allow enough privacy and intimacy. The basic climatic characteristics of the Mediterranean climate that apply to the whole area with minor variations are extremely warm and dry summers, and rainy and windy winters. These facts should play a crucial determining role in designing a house for a comfortable and healthy life. During winter season is necessary to ensure a favorable southern orientation in order to reduce the need for space heating. House windows oriented to the south with reduced openings to the north will prevent cooling in the

winter, but in same time is important to allow the possibility of ventilation during the summer months. In protection from the wind, it is necessary to take care of the creation of quiet windward zones, by the construction of walls, hedges and greenery.

In summer, it is important to provide protection from adverse sun exposure with elements taken from tradition that are complementary and quite applicable in modern architecture, such as: eaves, pergolas, shutters, sunshades, blinds, etc. Effective shading is also achieved by wisely greening. Traditionally known are typical examples of the planting of vines, kiwis, jasmines, bougainvillea and similar plants - climbers that covered the pergolas above the terraces and seating areas, but also grew on the facades of houses. Humidity providing in dry periods and cooling with water are known methods for achieving a more pleasant microclimate embodied through the frequent appearance of fountains and pools in yards, and by spraying yards or houses, watering plants, etc. The differences between day and night temperatures are significant in the most parts of the region and range around 20 ° C, which in summer requires daily closing of the house, while at night is necessary to cool and ventilate the interior and structure of the house. Creative solutions from traditional architecture allowed cooling, by flowing air through the house. Narrow openings on the north, from the shaded side of the building and the basement were used to draw colder air into the house, which after heating would come out on the openings of the highest parts of the house, through staircases or specially made ventilation towers. The flow of air without creating an unpleasant draft was facilitated by the construction of eaves and porches, but also by planting plants that directed the flow of air.

Construction with indigenous materials is one of the essential characteristics of bioclimatic architecture, which is reflected in the natural origin, tradition, experiential knowledge about material features, possibilities and applications. Contemporary use of traditional materials should be in line with the latest knowledge of their physical characteristics. Quality architecture will emphasize these principles and their application will create strong preconditions for the comfortable use of built spaces.

5.2. Size and shape of the building

Following pure logic, we can conclude that larger facilities will have higher energy consumption and less environmentally optimized solutions. Such facilities absorb large amounts of energy needed for heating, cooling and lighting. The size of the object should be created according to the number of members or users and adjusted to their real needs. Solutions in urban planning should be harmonized with the often conflicting requirements for the constant growth and expansion of settlements on the one hand and the need to protect free areas on the other. The optimal form that will allow efficiency in the use of the benefits of external influences and reduced consumption for heating and cooling of the building differs somewhat in the Mediterranean environment compared to the continental climate. While on the continent it is a compact shape, rectangular layout oriented to the south, with a reduced number of external walls, in the Mediterranean the optimization is oriented to the reminiscence of a house with an inner courtyard and ∏ or L shape floor plan. “The more complex shapes result to a number of additional factors intervening in their thermal behavior leading to the extra heating savings in the building. Such additional factors were found to be:

- a) The more composite internal layout encompassing more spaces and surfaces facing south.
- b) Larger internal thermal mass whose position, size and distribution reduce temperature fluctuations by retaining heat within it.
- c) Enhanced thermal protection on external envelope as a result of the courtyard morphology of the more complex shapes.
- d) More useful exchanges through openings and surrounding walls [6].”

In addition to the inappropriate size, there is a trend of increased demands for comfort, which implies the mandatory application of air conditioning systems, which are large consumers of energy, even when there are realistic possibilities for solutions without their application.

5.3. Thermal characteristics of the building envelope

Until the beginning of the eighties, residential buildings were made with little or no application of thermal insulation materials. Exceptional properties of insulation materials and their importance for improving the quality of housing and contributing to significant savings in heating and cooling began to be recognized 40 years ago. Due to the requirements of construction standards, decreasing of their original price and wide availability, these materials have been used more widely in the last twenty years, especially in new constructed buildings. By applying thermal insulation materials, the building envelopes become layered; foils or ventilating air spaces are introduced as methodology for improvement of the vapor diffusion characteristics. Proper insulation of the building reduced heat losses by 60-70% compared to conventionally built buildings. Considering ecological construction, it is important to use standard categorization of buildings according to energy consumption and environmental impact:

- conventional building - heat transfer coefficient for the structure is from 1.20-2.50 W / m2K.
- low-energy building - heat transfer coefficient for the structure less than 0.40 W / m2K, with a reduction of CO2 emissions by 30% compared to a conventional building.
- passive building - heat transfer coefficient for the structure less than 0.15 W / m2K, with a reduction of CO2 emissions by 60-70% compared to a conventional house.
- "zero carbon" building, is an autonomous system that produces the necessary energy from renewable energy sources, most often the sun, does not emit carbon dioxide and has a significantly reduced consumption.

Construction of passive houses brings possible reductions of energy consumption of 8-10 times compared to conventional construction, while this ratio for low-energy houses is measured by 3-4 times. In this way, additional investments in better construction of a passive house will be compensated in the period of 10-15 years. A significant segment of the ecologically balanced approach to architectural design is the selection and adequate application of materials that will be produced in an environmentally friendly way, but primarily materials that will achieve the goals of environmentally efficient architecture through the exploitation of the facility. Innovative appliance of traditional materials and constant following of current trends in the production of new materials and their use in new or existing facilities with the dissemination of knowledge related to this area should be imperative in the work of every architect. Almost all traditional building materials used throughout history are bioclimatic because they are natural and used from the immediate surroundings. Traditional materialization of stone, brick, wood, natural mortars and concrete, way of using, materials final processing, specific colors, with cubist, simple design are the basic features of Mediterranean vernacular construction, fully applicable in modernist, sustainable architecture. Vernacular materialization, processing and design are a reflection of availability, but also adaptation to the climatic conditions in which they were used. Today's technological improvements offer traditional structural elements such as external walls or ceilings made of brick blocks or foam concrete with significantly improved thermal characteristics. Technological solutions in the production of windows and doors allow more glass surfaces because these elements of the building are no longer places with large heat losses. Double or triple glazing with low-e coatings at a minimum distance of 16-20mm, application of inert gases between glass, better characteristics, higher quality and thickness of carpentry and locksmith profiles with professional installation have enabled significant improvements in thermal performance. In the Mediterranean, glass surfaces should have the possibility of protection from the sun by blinds, shutters, etc., which can play a significant role during the winter too, as protection from the cold. The wise use of fixed (eaves, sunshades, pergolas, etc.) and movable (blinds and shutters) sun protectors will drastically reduce energy consumption for cooling and additional mechanical cooling, very often, is not even necessary. The main issue for the installation of all these materials is those are more expensive and as such represent a greater initial financial burden in construction process. Therefore, it is necessary to further educate investors and designers and work on raising awareness of the long-term cost-effectiveness of mentioned

measures to improve thermal insulation features in new and existing facilities. Additionally, mass application should be supported by systematic strategies and conditioned by legal regulations and standards in construction.

5.4. Energy

The main aspiration of environmentally efficient architecture is to reduce the consumption of fossil fuels and CO2 emissions, which are the main cause of climate changes. In order to drastically reduce energy consumption for heating and cooling and in addition to the mentioned measures of improvement the thermal characteristics of building envelopes, it is necessary to provide equipment and lighting system with pronounced saving features. EU countries have stopped the sale of ordinary light bulbs and devices which do not meet the requirements of saving electricity, since 2010. One of the key and very urgent priorities is the use of energy from renewable sources: sun, wind, water and biogas. The future of energy development will go in mentioned directions on the global and on the level of state policies, as well as in the domain of architecture and urbanism. Design solutions for settlements and buildings will provide wide use of solar collectors, photovoltaic cells and wind turbines. Energy efficiency, consumption reduction and renewable energy sources are interrelated primary features of future sustainable architecture. The Mediterranean area has exceptional potential in the development of renewable energy production systems. Due to specific climatic conditions, there are great opportunities for the exploitation of solar and wind energy in addition to existing use of hydro potential. A large number of sunny days, as well as those with wind and their distribution during the year offer exceptional potential for efficient use. They are applicable, both on individual buildings and in settlements or groups of houses when efficiency is even more improved. Beside active use of the benefits of solar radiation, its passive use through the orientation and concept of the house plays a significant role. The passive house is one of terms that is inevitably linked to ecological architecture. Definition of a passive house is described in detail and concretely by the standards that need to be met. The heat transfer coefficient for all parts of the structure must not exceed 0.15 W/m2K, while for windows and doors it must be below 0.80 W/m2K. Thermal (solar) collectors should be used for water heating and heating of the building, in complicity with extremely high level of thermal insulation which will fulfill annual need for heating below 15 kWh/m2. The total annual energy consumption of such a facility must not exceed 120 kWh/m2 [7]. Air passing from such a facility should be minimized, and air is supplied from the outside by pipes laid through the ground to aloud air preheating. All equipment and lighting of the building should be at the highest energy level. Such standards enable more efficient use and consumption which is 8-10 times less compared to a conventionally built facility. Construction of passive house is 10-25% more expensive, but it is considered that the additional investment will return back in 10-15 years of use [7]. Beside the concept of the passive house as an optimal solution is offered the so-called a low-energy house that is about 50% less efficient in savings, but the financial payback period is significantly shorter. Such drastic reductions in energy consumption have a huge impact on lower emissions and resource consumption and represent one of the basic directions of action in sustainable construction practice. In designing and building of new facilities, it is necessary to intensively implement the above recommendations and measures, while with existing facilities it is necessary to develop strategies and intervene in the rehabilitation of the current very poor condition in order to approach and achieve the parameters for construction of passive and low energy houses. The goal of comprehensive energy savings, and thus environmental protection, is to create preconditions for the systematic rehabilitation and reconstruction of existing buildings, and to increase the level of mandatory thermal protection of new buildings. The average old house consumes 200-280 kWh/m2 of heating energy per year, standard insulated houses under 100, modern low-energy houses around 40, and passive houses 15 kWh/m2 and less [8]. Significant energy savings could be achieved by careful application of energy efficient electronic devices and lighting, through optimizing the use of artificial lighting by designing houses with a greater exposure to natural light. Mediterranean architecture is the architecture of light and shadow; it is formed in an area of intense and clear sunlight. In the Mediterranean, sunlight is in use as a building material, which emphasize the play of cubes on the external surfaces, shaping the interiors and adapting the amount of sunlight to the needs and climatic conditions. “Forms, dimensions, protrusions, locations are not the result of unfounded formalism, but are

dictated by the need of ventilation and natural illumination, by reason of the layout of indoor spaces and their orientation based on outdoor environmental features[9].” As result, traditional houses in the Mediterranean are introvert to be protected from overheating during summer and cold winds during winters. However, in modern architecture, the tradition of opening the Mediterranean house to the courtyard or by the use of blinds and eaves that prevent heating but allow natural light is more than applicable. New technology enables to use it, not only as protection from the sun, but also for energy production.

5.5. Water

Limited drinking water sources and a permanent increase of the population in the Mediterranean region are serious and very obvious problem. Such circumstances force us to reduce consumption and to be extremely inventiveness in water management. The problem treats the collection of rainwater in tanks and its use for watering, laundry and use in toilets. Next layer is treatment of wastewater by dividing it into water suitable for fertilization in agriculture and wastewater intended for deep purification treatment. First step is introducing devices that consume less water, similarly to energy strategy. Establishing serious strategies for water management, reductions in consumption and pollution of existing water resources could be achieved.

5.6. Technology

The development of technological solutions of interest for ecological architecture is reflected primarily in the lucid application of new and traditional building materials and systems for the production and use of renewable energy. So-called “smart” materials are applied and “smart” buildings are built that optimize energy efficiency, safety, security, communications and comfort. The principles of sustainability should be combined with the growing need for use of information and communication technologies, which are some of basic features of high tech architecture. Materialization and innovative application solutions in achievement of better thermal characteristics of the building envelope are the basis of any sustainable design. However, t is worth to mention that many of so-called innovative solutions are very expensive and not friendly from an ecological point of view in opposition to standard passive solutions. Wind turbines and solar systems that enable independent production and use of electricity, preparation of hot water and heating systems are subject of continuous improvement. Such effort should be directed to improve production and using efficiency of mentioned systems, their accessibility to a wider number community, by decreasing costs, shorter financial payback period and encouragement for the use of such systems.

5.7. Greenery

Greenery, above all, has a positive impact on human psychology what constitutes one of its most important features. The need to preserve greenery is reflected in the fact that the plant world is the most efficient way to reduce the amount of CO2 in the atmosphere. Biodiversity, its conservation and improvement is one of the strategic goals of sustainable development. Constant and consistent work is first condition to protect existing and to create new green zones inside and outside of urban areas. Successful examples of integrating architecture into greenery and greenery into architecture are always good example of a qualitative achievement in design. In addition to the indisputable aesthetic qualities, it is known that the coordinated design of greenery and the building brings significant benefits such as protection from the sun and wind.

The use of greenery on the roofs and facades of buildings is becoming one of the most desirable systems of passive design. Green roofs and facades create shaded surfaces by preventing unwanted summer heating, while in winter they mitigate wind gusts and reduce the cooling intensity of the building envelope. Very important benefit of greenery use is recognized in the improvement of microclimatic conditions by humidifying the air in the dry summer months, in cools down of the immediate surroundings and the air quality is much improved. Those features represent a fundamental difference in comparation to other shading elements. "The evapotranspiration and the exchange of air between the vegetation and the external air play an important role in the hydrothermal state of the vegetation and also have an effect on the flow of heat through the roof [10]." Plant

selection will depend on climatic conditions, but also on the position in the building surrounding. Creepers and climbers will be used on the facades, while low shrubs and plants that surviving extreme weather conditions will be used on the roofs. Especially developed technologically and conceptually systems are used for supporting and planting plants. Double-skin systems of green curtains should be provided for facades on the way to enable easy assembly and disassembly, as well as minimal maintenance.

6. Benefits of applying the principles of environmentally efficient architecture and expected results

Quality insulated walls will reduce heat loss by 60-70%, and save 100-150 euro per year in the average household. Recent research indicates that low-energy houses designed according to environmental settings emit about 2.8 tons of carbon per year compared to conventional houses whose emissions are 4.2 tons of carbon per year, what is difference about 30%. Next step should be the intention to design and build “zero carbon” or carbon neutral houses and settlements where this emission is reduced to a minimum or does not exist at all. The energy used by such facilities is exclusively from renewable sources, most often the sun. Increasing the use of solar energy will be supported by expected increasing of the energy production efficiency of solar systems and reducing, still high application costs. Calculations published by the TCPA (Town and Country Planning Association) show that investing of 1,000 euro in solar water heating and electricity production systems, reduces CO2 emissions by 1,800 kg / year. Even more profitable investments are in the case of using wind turbines where the investment of 1000 euro results in a reduction of CO2 emissions by 3000 to 18000 kg depending on the size of the plant. The use of a 2.50 m diameter wind turbine with a power of 1 kW covers the electricity needs of a household and reduces carbon dioxide emissions by 1 ton per year, while a large wind turbine of 80 m will reduce emissions of CO2 for 1400 tons and it will supply 1500 homes [11]. Research that has been done under the sponsorship of the Office of the Mayor of London, indicates that additional investments in renewable energy sources: solar, wind energy, biomass, heating and cooling from the ground, in amount of only 1% of total construction investment will result with energy savings in amount of 10-50%, depending on the purpose of the facility and the way of using the energy [11]. If all these positive parameters are added to the well-known, outstanding environmental impact of systematic planning and planting of greenery and its protection, which is reflected in the improvement of microclimatic conditions of the site, noise reduction, high aesthetic qualities, and the establishment of practically the only active CO2 reduction system, remains unclear why human civilization is not taking a stronger turn toward a sustainable future, especially when we know how serious are the warning signs that nature, almost daily, sends us.

7. Conclusion

Sustainable, ecological or green architecture implies positive repercussions by itself. However, due to business-oriented construction industry, the share of such buildings is negligible compared to conventional types of construction. Based on stated it is necessary to establish systems for introducing and application of sustainable thinking in architectural design and construction. It is high time to act and it is necessary to work quickly and efficiently on the establishment of legislation, regulations and standards, as well as on the dissemination of knowledge and raising awareness of the benefits of an ecologically oriented practice. The most significant effects of the application of the principles of sustainability are reflected in cleaner air and water and reducing emissions of harmful greenhouse gases into the atmosphere, reducing the consumption of all types of energy, establishing independent energy systems using renewable energy sources, reducing drinking water consumption, new planting, strong protection and clever use of greenery.

Beside the most important parameters of environmentally friendly design, ecologically oriented architecture takes into account the use of recycled and renewable materials generated from waste raw materials and the use of materials in accordance to idea that impact on the environment should be minimized.

Important role is secured for proper waste management based on recycling, composting of biodegradable waste materials and its use in agriculture.

Development of public, bicycle and pedestrian transport in the Mediterranean settlements should be promoted through better preconditions for these modes of transport.
Urban development improvements oriented on residential buildings with gardens where is possible to grow organic fruits and vegetables, is certainly one of the features of ecological thinking too.

References

[1] A. Zoranić, "Modern architecture and Mediterranean Context" in Proceedings - CAUMME 2012, Global Impacts and Local Challenges Faculty of Architecture Yildiz University, Istanbul, Turkey, 2012.

[2] D. Bradbury, Mediterranean Modern, Thames & Hudson Ltd, London, UK, 2006.

[3] J. F. Lejeune and M. Sabatino, Modern architecture and the Mediterranean, Routledge, Taylor and Francis Group, London, New York, 2010.

[4] F. Šrajer, Mediteranska kamena kuća-tehnike gradnje i obnove, Institut za turizam, Zagreb, Croatia, 2008.

[5] A. Hadrović, Bioklimatska arhitektura, Arhitektonski fakultet, Sarajevo, BiH, 2008.

[6] D. Serhides, „The Wisdom of Mediterranean Traditional Architecture Versus Contemporary Architecture – The Energy Challenge,“ *The Open Construction and Building Technology Journal*, no. 4, pp. 29-38, 2010.

[7] “What is passive house.” passive.de. https://passivehouse.com/02_informations/01_whatisapassivehouse/01_whatisapassivehouse.htm, (accessed 22.12.2009).

[8] Ž. Hrs, Borković, Vodič kroz energetski efikasnu arhitekturu, Ministarstvo zaštite okoliša, prostornog uređenja i graditeljstva, Uprava za stanovanje, komunalno gospodarstvo i graditeljstvo, Sektor za graditeljstvo: Energetski institut Hrvoje Požar, Zagreb, Croatia, 2005.

[9] F. Giucastro, „Natural light and energy efficiency in built environment. From the traditional Mediterranean house to DSCs.“, in Color and Light in Architecture First International Conference 2010 Proceedings, Facolta di Architettura di Siracusa, Universita di Catania, Italia, 2011.

[10] G. Perz, L. Rincon, A. Vila, J. Gonzalez, L. Cabeza, „Energy efficiency of green roofs and green facades in Mediterranean continental climate.“ intraweb.stockton.edu. http://intraweb.stockton.edu/eyos/energy_studies/content/docs/effstock09/Session_11_1_Case%20studies_Overviews/102.pdf (accessed 29/02/2012).

[11] TCPA, Sustainable energy by design, TCPA, London, UK, 2006.