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Investigating the Aspects of Environmental Sustainability Approach in Designing Aquatic Sports Complex

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Abstract

The subject of sustainable development has been debated by experts and researchers in different fields of architecture and urban development for the past few decades. One of the most important goals of sustainable development is to safeguard the nature and adjust the approaches to nature and the expression of sustainable development in the field of artificial environment is called sustainable architecture. Because of the shortage in non-renewable energies and today's need of architecture for sustainable designing; and on the other hand, creating equal conditions in using facilities and also physical and social welfare, the designing of every project must be presented in a way that observes a sustainable environmental architecture so that the process of controlling the non-renewable energies in the country is helped in an effort to pose the least amount of damage to the environment and also, to fulfill the basic human needs. With regard to the fact that aquatic sports, because of their advantages, have attracted a great number of enthusiasts from all age demographics, the necessity to regard these sports from a higher and more public perspective is felt. This approach not only must regard the way these sports are presented to the public, but also what characteristics and attractions it must have to cause the increase the level of peace in the society. Creating this type of centers in the society, especially in an obvious way leads to filling leisure time and prevents social and environmental abnormalities. This paper aims to achieve some of the goals of environmental sustainability in designing modern aquatic sports Complex by an analytic-practical method.

Keywords: Sustainable development, environmental development, aquatic sports, designing

Introduction

Development is one of the most important concepts that had and have impacts in the consecutive, aimed and at the same time fluid advancement and expansion of every scientific field. The concept of development in architecture and urban development has become synonymous with the concepts of advancement, growth and expansion. But each of these concepts have different and specific scientific meaning. One way or the other, sustainable development in architecture and urban development can help expand economically to improve the architecture and urban economy in the sense of advancement, lead to constant and increasing movement in being in modern scientific and cultural trends, in the sense of expansion and can result in the city's skeletal development. After a century of experience for the modern architecture, with its valuable achievements and evolutions, complicated problems take place in the field of the environment. The state of the affairs at the dawn of the 21st century indicate a trend of a non-sustainable development among whose features are growth of the population, increase in consumption and immethodical distribution of resources. Growth of the population, such as the western lifestyle dictates, is a great infliction on natural environment that has led to climate changes, holes in the ozone layer and decay of species and natural habitats in our times which leads to the change in consumption culture and the change in human's approach toward nature.

Following these changes, a new concept entitled sustainable development has been presented and because of the important role of the artificial environments in the process of sustainable development, environmental sustainable development has become the center of attention for ideologists. Today, when the pressures of life and mental tensions have increased to a large extent, people's lives are facing a monotonous nature and they have become in need of entertainments as excuses to get together and be free of the routine errands and tiresomeness of life, the existence of aquatic spaces that causes the function of their five senses, take the tiredness away from them and creates a sense of joy and peace in them, it is felt that they can cause the appearance of joy and peace and also increase the efficiency of individuals and growth of the society.

Research methodology

According to the subject of this paper which is investigating the aspects of the approach of environmental sustainability in designing aquatic sports Complex, studies on the aquatic sports Complex and analyzing the strategies of sustainable development and principles of sustainable architecture must be in the attention. In the end, with regard to the results from the studies, a framework is reached on which base a pattern for designing architecture is achieved. In terms of the type of the goal, this study is categorized among practical researches. Also, the type of the data in this research include quantity and quality data.

Sustainable development

Sustainable development means presenting solutions as opposed to the traditional skeletal, social and economic patterns of development that can prevent issues such as the decadence of natural resources, elimination of the ecosystems, pollution, immethodical growth of the population, increase of injustice and reduction of the people's quality of living. A green architecture must include more than a single building around itself and be a sustainable form of its urban environment. The city is an entity beyond a group of buildings. In fact, it can be regarded as a series of balancing systems, systems for living and entertainment that have skeletons in the form of artificial forms and with an accurate look at these systems the landscape of the future city can be drawn. The concept of sustainability demands the accurate equation between the forceful needs of today and the needs of tomorrow, between the private needs and public measures in the limits of individuals' greed and mercy and social sympathy. Sustainable development includes a concept of economic growth that leads to welfare and the creation of opportunities for all the people of the world as it does not seem fair that a this limited amount of the world's natural resources are destructed for private interests (Ahmadi, 2003).

Table 1: Sustainable development model

People must be in the center of the attention. Saving the environment has a vital aspect, not the goal in itself, rather, like economic growth, is only a means.	1
Development models must be based on environment-friendly technologies.	2
The true value of environment must be reflected in all the processes of decision-making with a strong motivation.	3
Models of sustainable development must be based on providing the grounds for universal participation and attention to the status of the society.	4

According to the Global Commission of Environment and Development, the basic subjects of development include population and development, food security, diversity of living species and the environment, energy, industry and urban challenges. Based on this principle, the Global Commission of Environment and Development acknowledges sustainable development as a pattern of development that fulfills the human needs without eradicating the capabilities of future

generations. Without a doubt, sustainable development, especially sustainable development in urban structure and in the form of concepts such as urban designing and sustainable architecture is only achieved through the improvement of the quality of urban life and increasing citizenship welfare (Naqizade, 2002).

Table 2: Principal policies of sustainable development

Minimizing the consumption of non-renewable natural resources (such as fossil fuels and insufficient sources)	1
Stabilizing the consumption of non-renewable natural resources (like underground waters, soil and plants)	2
Keeping the level of production of waste and pollutions in the level of the capacity of local and global absorption (like greenhouse gases, ozone-damaging chemicals and toxic waste)	3
Providing the basic human and social needs (such as access to means of life, having the right to choose, collaboration in determining the social destiny, access to a healthy environment and basic services)	4

Sustainable architecture

Global warming, the thinness of the ozone layer because of the utilization of different type of pollutants, increase in the pollution of the environment and extinction of species all gather together and make the necessity of ecology and environmental issues for the future easy to predict in a way that the gaining grey as opposed to the future green world is the most thought-provoking issue of this century (Mehri, 2009). Here, development, as one of the biggest factors in changing the environment and consequently, construction, which is considered as one of the biggest industries in employing human resources (hundreds of thousands of construction workers and related techniques) lead to the destruction of agricultural fields, erosion of the soils, pollutes the environments, risks the public's well-being and health and spreads the energy crisis. This crisis was considered a warning for the whole world in the mid-1960s with the increase of the amount of environmental pollution and caused the formation of environmentalist groups that have routed for the environment in the world and followed an expansive concept entitled sustainability.

Table 3: Sustainable architecture terminology

Sustain: Protect, keep alive, continue constantly
Sustenance: Process of life sustainability
Sustainability: The word that defines what leads to peace, nurture and procurement of life and consequently, results in continuance of life and belonging it.
Dehkhoda have stated sustainability in the sense of durable. The current meaning of the word sustainable which is also meant in this topic is what can endure in the future.

Sustainable construction

Sustainable construction is defined as managing a clean and healthy environment based on an effective utilization of natural resources and ecologic principles and the goal of designing sustainable buildings is to reduce its damages on the environment, energy sources and the nature. Therefore, sustainable building can be defined as the building that has the least amount of conflict and aversion with its surrounding environment, and on a larger scale, the region and the world. Construction techniques in an expansive field make effort to provide an equal level of quality in economic, social and environmental terms. Therefore, the rational use of natural resources and the appropriate management of construction helps safeguarding the limited natural resources and reduce energy consumption and leads to an improvement in the environment quality.

Designing a sustainable building

Sustainable designing is the thoughtful collaboration between architecture, mechanic, electric and structure engineering. Added to the common factors of designing like beauty, relevance, texture, shadow and light and facilities that must be considered, the designing group must also pay attention to the long term environmental, economic and human factors. Therefore, sustainable architecture includes a combination of a number of values including aesthetics, environment, population, politics and in other words, designing and construction in accordance with the environment. An architecture must intelligently consider a number of factors that are the building's endurance and age, appropriate materials and the concept (Zandie, 2010).

Sustainable optimization of the building is an executive process whose final goal is utilization in the environment, energy and assets in the building. This goal is reached by using methods of increasing energy efficiency and the use of materials that are in accordance with nature and designs with multiple aspects for the utilization of energy and the optimal designing of interior and exterior space of the buildings. Applying this plan causes optimization in energy consumption, recycling the waste and materials and reduction of the expenses for safeguarding the building.

Table 4: Sustainable designing and its primary principles

Sustainable designing begins with environment understanding. If we were to be aware of the environmental facilities that we are in, we could prevent damaging them. Understanding the environment causes the clarification of the stages of designing including the direction of the placement in relation with the sun and the way the building is set within the site and how to keep the surrounding environment and how to access the transportation system and walking paths.	Environment understanding
Whether the building was in an urban area or a more natural one, natural connection gives life to the designed space.	Relation with nature
There is no waste in the system of nature. A creature's dead body becomes the food for another. In other words, this system demands the respect of the human beings to the needs of the different species.	Understanding the processes of nature
Sustainable designing tries to understand the impacts of the environment through evaluating and analyzing the site: Evaluating the consumed energy, the toxicity of the materials and techniques of construction	Understanding environmental impacts
Sustainable designers know the importance of attention to each idea. Collaboration with consulting engineers and other experts take place in the beginning stages of designing.	The collaborative process of designing
Sustainable designers must pay attention to the culture, religion and race of the people for whom they are designing	Understanding the people

In his book Animal Morphology, Williams correctly states that the attraction of imitating nature for architects is that it gives a closer perspective of the evolution of form and function (in the same light, architecture is considered to be an imitation of nature as a development of modernism). This science is committed to present new methods through which the structure would respond to the clients more accurately and more desirably than the present mechanical system and have interaction with them. In a deeper level, in the words of George Grinidimis from Redding University, architects are attracted to this trend because we are all parts of the same environment. He believes that insistence on doing more harmonious constructions with nature is a true environmental insistence and is not merely a romantic necessity. The science of imitating nature is the common ground for three different methods and therefore, it needs an understanding of biology, environmental physics

and the science of matter. It is clear that the vastness of view and multi sided debates can clarify the issues and the state of the affairs (Maknoun, 1997).

Table 5: Goals of environmental sustainable designing and presenting case suggestions (Azarbayejani, 2003)

Maximizing human's peace by absorbing daylight, beautiful scenery, desirable air quality, proper noise insulator, proper temperature control, controlling the amount of humidity, effective quality supervision and necessary security predictions, proper human control	1
Practical planning to reach a proper movement of the users in the space, creating an achievable security, facility in adaptation and interchangeability in the capability to respond to the needs of the users, combination of the building's structure with the facilities	2
Designing for change by a simple and modular designing that could adapt itself to development and increasing needs, creating facility to change the plan and functions within the building	3
Keeping and valuing natural values by combining them with the wild nature and animals and attention to the sustainability of all the micro-organisms, attention to the green conditions, collecting rain water and recycling drinking water, effective waste recycling	4
Minimizing the regular energy expanses using the maximum amount of free energies like daylight and sun heat	5
Controlling changes in the temperature, proper heat insulation, effective and proper methods of controlling and practical building systems and using them	6
Maximizing the used spaces by minimizing the area of the gardens within the building, minimizing the space for air canals, maximizing the combination of the structural and facilities' elements, attending the necessity of artificial ceiling	7

Aquatic sports complex

Four general sections are considered in aquatic sports Complex, each of which have some subsections. The first section is the main pool hall, the second is open air waters and the third is the office. The most important section of this complex includes the pools. Training pool, local competition arena and children's pool in which observing the standards is of grave importance. On the other hand, considering suitable spaces for the spectators has a special significance. Added to that, considering spaces like the sauna, Jacuzzi, gym, aerobics hall and pool house is important. Furthermore, if the servicing areas of these sections did not have a suitable quality, it leaves a bad impact on the quality of the sections themselves. The different sections of these areas include service spaces, office spaces, facility spaces, sport and entertainment spaces which in turn consists of pool halls, sauna and Jacuzzi, gym and aerobics arena and pool house.

Pool

According to the type of activity (educational, training, competition or entertainment) has features that should be considered in the beginning of the stages of planning and designing. Pools may have one or several purposes. Pools may also be designed in chained and separate shapes as a series of some pools next to each other. Chained pools, although have an even look but provide the possibility to segregate and if it was needed, each section can also present the function of a specialized pool.

Although open air pools cost less to make and keep in comparison with ceiled pools and although they enjoy nature, plants and sun which provide a much more desirable and more attractive condition, in practice do not have the efficiency of the ceiled pools.

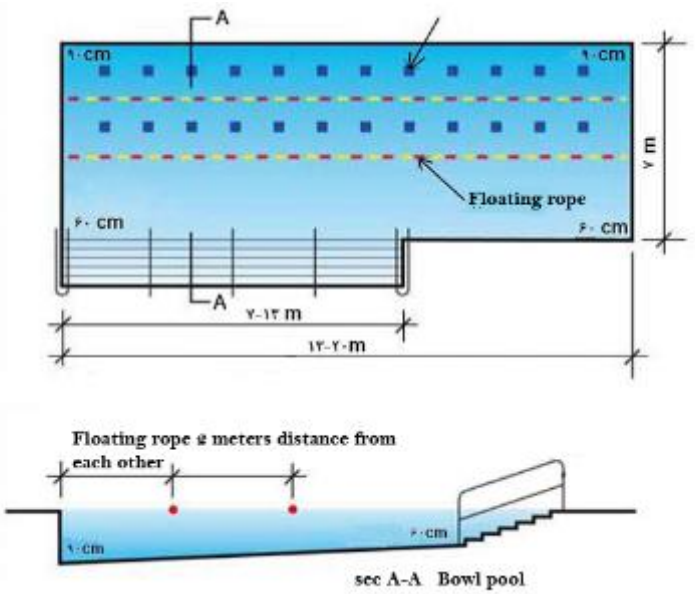

Figure 1: Plan of children's pool

The short period of utilization during the year causes the abandonment of all the facilities of the pool in most days of the year, lack of attention to providing permanent personnel, lack of a clear system of protection and keeping the facilities and lack of a unified and stable management.

Therefore, it is suggested that open air pools should be devised within a sport complex or next to ceiled pools or with the use of light and folding ceilings to extend the utilization time to the whole year.

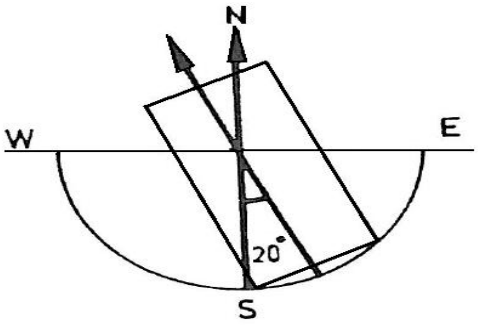

Figure 2: Optimal orientation of open air swimming pools

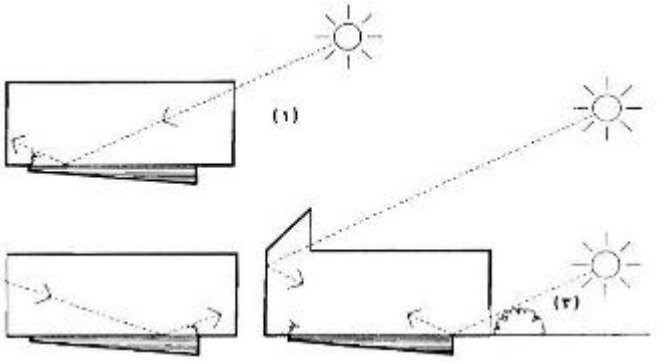

Figure 3: Natural lighting of the halls
(source: Technical regulations of the sport arenas of the country)

Principles of environmental sustainability in designing aquatic sports Complex

In today's world, with regard to the access to limited fossil fuels and increase in the amount of energy consumption in comparison with the past, having new sources of energy is of great importance. However, added to this necessity, reduction of environmental pollutants and also reduction of air pollution has led to the use of green or environment-friendly energies like wind energy, hydrogen energy and other renewable energy sources which have the least amount of environmental pollutions are in more attention. Solar, wind, aquatic, biomass and geothermal energies are among the most important sources of green energies. It is interesting to know that for every kilowatt electricity per hour that is generated from renewable energies, instead of coals, the release of carbon dioxide reduces by approximately one kilogram which is a notable number. Analyses that were done indicate that the generation, transformation and consumption of energy by men is one of the most important, and in fact, the biggest factor in the increase of environmental pollutants and this is when in today's world, not only are we not able to keep energy consumption at a stable level, but also it is predicted that in future years, with the increase of population and the infiltration of technology in different aspects of people's lives, the energy consumption would increase notably in comparison with the past (Qaffari, 2002).

Walls

The structural system of the pools' walls must be in a way that the forces from earthquakes are equally distributed and prevent any kind of focus on the corners, or with the use of sufficient amounts of metal, the corners are empowered. The minimum thickness of the pool's cement floor is suggested in the amount of 20 centimeters. In the parting points of the pool's walls to the floor, it is suggested to use cement muscles in the following way.

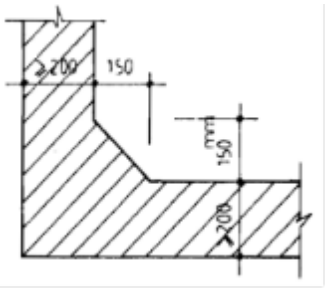

Figure 4: Cement muscle in the pool's wall
(source: Technical regulations of the sport arenas of the country)

Water circulation in the pool

The goal of the water circulation system in the pool is that the polluted water is constantly and effectively is taken out of the pool in a certain amount and is taken to the detox center and finally, it is sent back to the pool after purification so as to reach the amount of the predicted detox and the purity of the pool water. The efficiency of the water circulation system depends on the amount of the water's return and the sequence of taking the polluted water and returning the purified water to the pool.

Ventilation

In today's pools, the option of the ventilation mechanical system is devised not only for the surrounding space of the pool because of the high amount of humidity and chemicals in the water, but also for other spaces that are related to the pool such as cloakrooms, showers, other places of washing, etc. are also devised. This causes the imposition of a great load on heating systems during the winter. It must be noted that the most share in the heating system of the pool's building is given to the ventilation system option. It is also suggested that in the place where the ventilation ducts are

placed, the entrance duct of the fresh air and the evacuation duct of the pool's air in the ceiling be placed close to each other to create a kind of small flow of air between the two ducts.

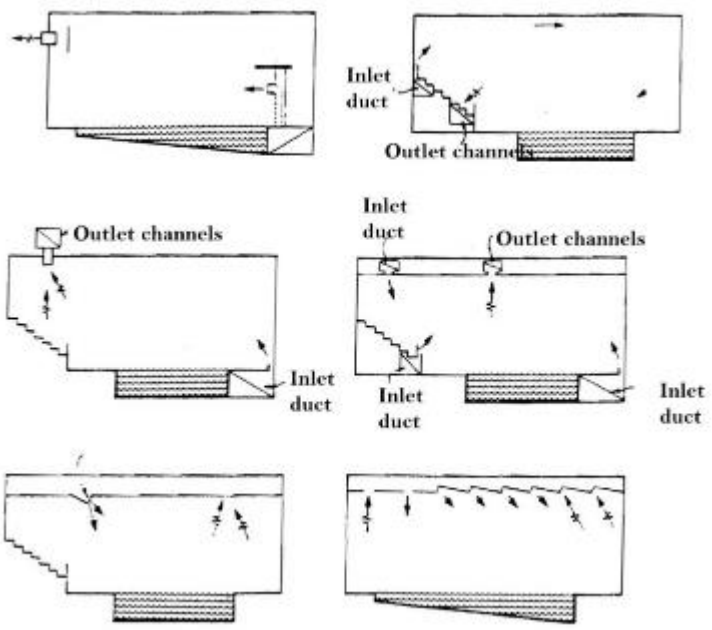

Figure 5: Different systems of air distribution around the pool (source: Technical regulations of the sport arenas of the country)

Building's ceiling cover

The building's ceiling is covered with a transparent material called ETFE. The endurance of this material is about 20 years and is very light and insulant. It also lets light in easily.

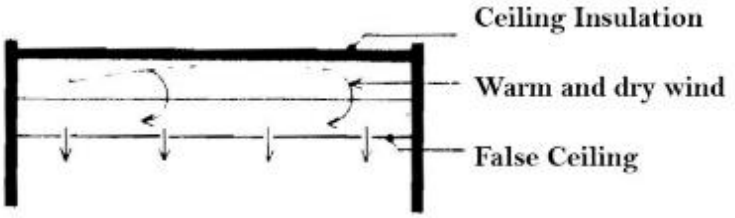

Figure 6: Blowing dry and warm air with great pressure (source: Technical regulations of the sport arenas of the country)

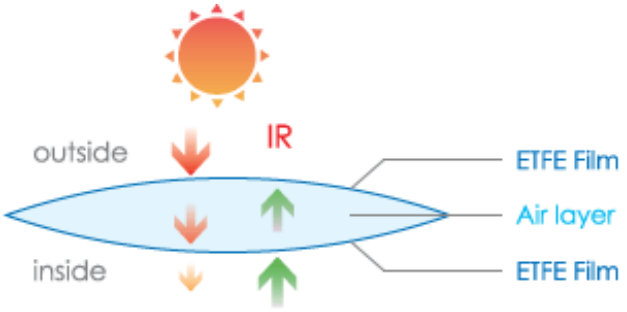

Figure 7: ETFE

This plastic material is very hard and can be used again. In comparison with glass, it lets the ultraviolet rays more and is cleaned each time it rains. Furthermore, it is more insulating that the

glass and is very resilient against the effects of the sunlight that causes the change of color and nature. Swimming and aquatic games centers need heat energy in a great amount, but the use of ETFE in this project causes the creation of greenhouse effects in a very desirable way. 20 percent of the heat energy that reaches the building is kept within the building and is utilized for heating the swimming pools and interior spaces.

Optimization in energy consumption (optimization and saving energy)

The energy crisis, environmental pollutants, global warming phenomenon and heat island of great cities are among the issues of the present century all over the world and all these cause a great amount of energy to be used to heat and cool these spaces. With a rational utilization of natural resources and a proper management of constructions, we must help save our limited natural resources and decrease energy consumption which is one of the solutions for designing sustainable or green buildings in which the waste of energy must be prevented and cause the reuse of energy (recycling) by presenting solutions. One of the most important factors of sustainable architecture is the prevention of energy waste and recycling energy and using green spaces in the buildings and also the sue of materials and technologies in accordance with the region, which have an important role in optimizing energy.

Using recyclable energies

There are many ways for the use of clean energies like solar, wind and aquatic energies to generate electricity and optimize in the consumption of fossil fuels.

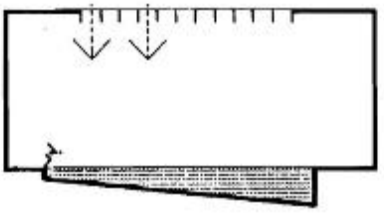

Figure 8: Sun radiation with an angle of maximum 50 degrees in relation to the horizontal level

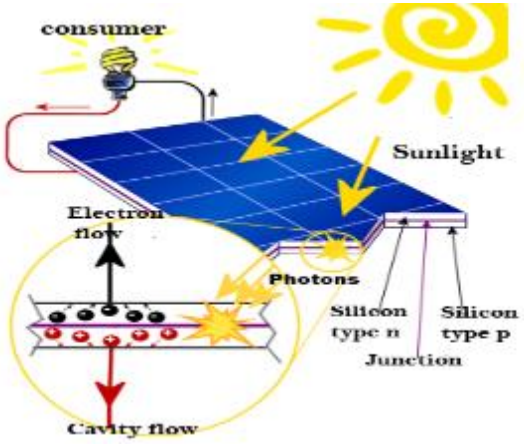

Figure 9: Solar cell

If the clean energies were to be used to generate electricity, as it is limited, more accuracy needs to be applied in the way the generated electricity. Furthermore, in building, the use of heating and lighting devises that work by being plugged in and consume electricity, must be avoided as much as possible.

Conclusion

The sustainable architecture's recent endeavors have decreased this issue to a great extent. One of the principles that have been in the attention regarding this issue in the past few years is that architecture must look for the future. Architecture must always accept new unpredicted patterns and technologies and endure regional and environmental changes. One of the goals of sustainable architecture is designing and keeping the building for the future. The long age, together with the capacity of renovation is meant. This is important both in terms of keeping the physical endurance of the building and its resilience and also in terms of saving the environment, nature, primary sources of energy and eventually, the whole planet Earth. The field of the construction industry that is related to physical endurance and long age has a direct relation to the structure and must be in a greater attention. Therefore, the subject of sustainability in the structure inevitably arises.

One of the principles of sustainability is to design and construct to give long and efficient services. The structure engineer, as a member of the designing team in order to provide efficient and harmonious systems that can minimize energy consumption and production resources plays an important role. A great number of the owners and designers understand the profitable results of the process of a unified designing. A complete team that enters the designing process from the beginning can reach a green and economic solution much better. The concept of sustainable development and sustainable architecture, with regard to their primary regulations, consider the safeguarding of environment with the approach toward saving nature. Consequently, using environmentally sustainable architecture designing, a designing which together with fulfilling its functional needs, reduces energy consumption and saves the environment can be reached.

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