

Green Architecture, a Path to the Future

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ABSTRACT

Growth of population and technology and its incompatibility with the environment has cause extensive changes and disrupted natural conditions of many spots in the world. Adverse effect of modern technology on environment has awoken a new awareness of environmental issues in people. Achieving sustainable development requires sensible use of natural resources, substantial change in human's attitude toward nature and reconsideration of production and consumption patterns. "Sustainable architecture" or "green architecture" which has attracted the attention of many architects with different points of view all over the world. In The global movement toward sustainable development, architecture is absolutely a main leading factor, because buildings and structures are the most important and extensive changes humans have made on the earth. Since strong and weak points of a structure directly affect habitat of the world, special responsibility is on people and particularly on architects in this field. In this study, the above subject is discussed along with an example of the projects build according to green architecture to contribute to changing the world form today's gray world to future green one.

KEYWORDS: Sustainable development, Green process, Sustainable design, Environment, Energy.

1. INTRODUCTION

Adverse effect of human on nature doesn't go back long ago and is a new phenomenon which depends on two important factors namely growth of population and domination of human population on nature. Excessive exploitation of natural resources increased with the beginning of industrial revolution. In addition, existing natural resources couldn't respond to human needs and industrial consumption. And thus started being depleted. This caused a distorted relation between human and nature. 1970's was when human become aware of environmental crises and started to react sensibly. Sustainable development is one of those reactions. With The industrial revolution and technological developments coming into existence in field of architecture, vernacular architecture which all over the world was affected and formed by the local nature and the surrounding environment and was compatible with climate started to face away. Modern architecture, which was the product of these changes, wholly overlooked the formation basis of architecture. Green architecture originates from sustainable architecture and sustainable development which is a response to human needs when forced with the adverse consequences of the industrial world of the present age. Preserving natural sources, being immune from weather pollution and other environmental pollutions, physical and mental hygiene and the future of humanity are subjects of discussion in case of sustainable architecture and sustainable development. Generally green process is mentioned all subjects are correlated to each other and case each decision all consequences must be considered and naturally taking account of principles and criteria separately will openly contradict the essence of green process.

2. WHAT IS GREEN ARCHITECTURE?

Green architecture is more commonly known as sustainable development. The term explains technique in architectural design which is parallel with environmental views and is basically formed in respect to the nature. Green Architecture is not literally a new trend. In Many archaeological civilization and traditional architecture of Iran it was an integrated fundament of architecture. Having been faced with negative consequences of the industrial world, preserving the world's natural resources is one of the top priorities of the present-age human. And this is why green architecture always seeks ways to minimize negative effects of buildings on the environment. In order to contribute to preserving the nature through increasing efficiency and optimizing material and energy consumption as well as space expansion [3]. Thus in green architecture, instead of being an enemy for the nature, we harness its energies and utilize then in buildings. For example in a green building, recyclable material is used instead of substances and materials that pollute the world. When a building is made up of materials in its vicinity and is stable enough, will be a part of nature. In mounting such structures, providing convenient transportation to reduce personal car use is an important issue. Also directions should be adjusted such that maximum natural light and thus free energy (e.g. Equipping the building with solar water

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heater) is achieved. What is important is such buildings are to make it possible for the nature to enter the building (e.g. making cuts in the form and filling them with green space) (figure 1).



Figure 1: Future of green architecture [7]

3. GREEN ARCHITECTURE PRINCIPLES

▪ PRINCIPLE 1: PRESERVING ENERGY

Each building should be designed and built such that its fossil fuel requirement is minimized. This principle used to be taken into account in the past. Nowadays although a wide variety of technologies and materials are available this priority has been neglected. This trend should be altered and, using new technologies and materials, building's dependence on fossil fuels must be reduced.

▪ PRINCIPLE 2: UTILIZING WITH THE CLIMATE

Buildings should be designed such that they are able to use climate and local resources of energy. Location and placement of the building along with expansion of interior spaces improve the level of comfort inside the building. Also, insulation can significantly reduce fossil fuel consumption (figure 2).

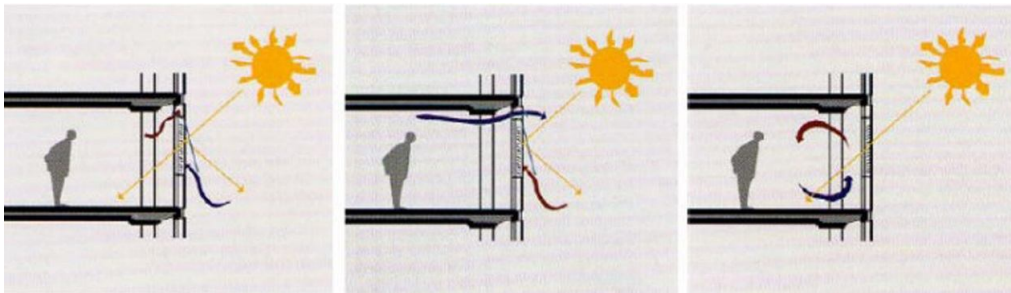


Figure 2: Using double-glazing and its effect on proper ventilation in fall, spring, summer and winter (left to right) [8]

These two trends have overlaps in many occasions and have a lot in common. The tradition of “design based on climate” in order to provide comfort inside the building is not limited to heating regulations and in many climates, architects are required to design cool spaces to create favorable conditions inside buildings. The common approach in the present age; “Using air conditions system” is an inefficient method. Because, not to mention high energy consumption, it will contribute to air pollution [4].

▪ PRINCIPLE 3: LESS USE OF NEW RESOURCES

Every building should be designed such that use of new source is reduced and after its useful life, like building can create a source to develop more buildings. This reuse includes recycled material or recycled spaces. In most cases when there is limited access to new sources, methods are devised so that a building made to serve a particular purpose can be used for other purposes.

Any change in old building made for new uses can impose extra costs and problems. However advantages of reusing these huge buildings in urban environments outweigh the costs and problems. Rehabilitation of the existing building in big and small cities can preserve the resources used to destroy and reconstruct buildings and they the urban environment is not destroyed.

▪ PRINCIPLE 4: RESPECTING USERS

All buildings are made by human, but in some of them the fact of human presence is respected while in others rejection and disrespect of human dimensions in the construction process is detected. It's important for a professional architecture to notice that the quality of materials and the construction process is as important as for the whole human society as it is for the workers and users. Another aspect of human contribution which should

be noticed is the positive contribution and involvement of users in the design and construction process which otherwise leads to waste of a useful efficient source.

▪ **PRINCIPLE 5: RESPECTING THE SITE**

Australian architect “Glenn Murcutt” makes this strange statement “A structure should gently touch the ground”. A building that greedily consumes energy, causes pollution and is not friendly toward the users and consequently doesn’t gently touch the ground. It’s impossible to take a building out of the site in which it had been built and create the same condition in the site as when there was no building in it [5]. Although nowadays people have abandoned the sedentism¹ and architects have begun the design process, the need for temporary structures for especial occasion such as exhibitions is still felt (such structures usually have the shape of tents or settlement where suburbs and slum dwellers are accommodated).

▪ **PRINCIPLE 6: HOLISM**

It is not easy to find buildings with required principles of green architecture because it is not still completely recognized. Green architecture should be more than a single building and should include a sustainable shape of urban environment [6]. City is an existence beyond a group of buildings. In fact they are an assortment of interacting systems. They are systems designed for living, recreation in different shapes. With a close look at these systems the portrait of the future cities can be drawn.

4. GREEN ARCHITECTURE 3 SPECIFIC PRINCIPLES

Recognition of these concepts assists the architect to have a deeper understanding of his surroundings.

▪ **ECONOMIZING ON RESOURCES**

This principle, on the one hand introduce proper use of nonrenewable sources of energy such as fossil fuels in order to reduce fuel consumption and on the other hand provide methods to control and properly use natural resources as renewable and sustainable sources (figure 3).

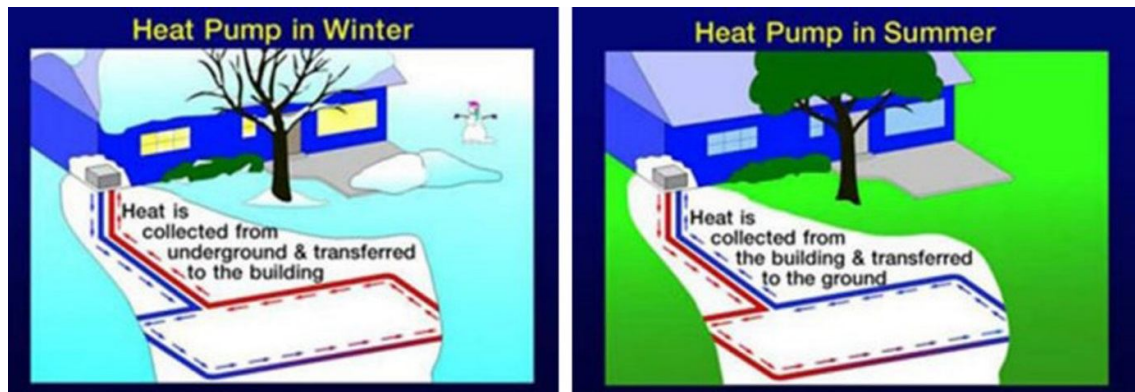


Figure 3: Indirect and local use of geothermal energy through pumping the heat generated from underground resources [9]

▪ **LIFE CYCLE DESIGN**

The second principle is based on the idea of using a material with convertible shapes while maintaining its useful features (figure 4) [1].

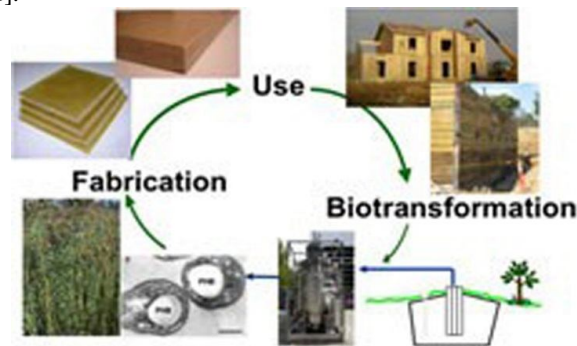


Figure 4: An example of recycling a material and reusing it in the building [10]

¹ In evolutionary anthropology and archaeology, sedentism (sometimes called sedentariness), is a term applied to the transition from nomadic lifestyle to a society which remains in one place permanently. Essentially, sedentism means living in groups permanently in one place.

▪ **HUMAN DESIGN**

This principle has roots in the needs required to preserve the element of ecosystem chain which guarantee the survival of human. This principle includes three strategies namely, “Preserving natural resources”, “Urban Design-Site design”, and “Human comfort”.

5. KEY INDICES IN THE ENVIRONMENT SUSTAINABILITY

- Minimum fossil fuel consumptions in the production of materials, transportation, construction and buildings
- Making the best use of recyclable materials
- Avoiding use of chemicals that harm the Ozone layer
- Replacing materials that gets worn away or pollutes the environment
- A design which makes the best use of light even in places will limitations
- Applying facilities in the frame work of a general program of environmental condition adjustment which reduces energy and increase level of comfort (figure 7)
- Using solar energy to receive heat and cold (figure 6)
- Application of simple control methods in buildings
- Finding methods and opportunities to yield electrical energy (figure 5)
- Devising methods to benefit from geothermal energy (figure 8)
- Minimizing water consumption, water purification and reusing it
- Developing strategies to regain the runoff water from rainfall through using hard materials and proper collection methods
- Providing pleasing exterior environment by installing shades to alleviate scorching heat of summer and increase humidity if needed



Figure 6: Using solar panels in the façade [12]

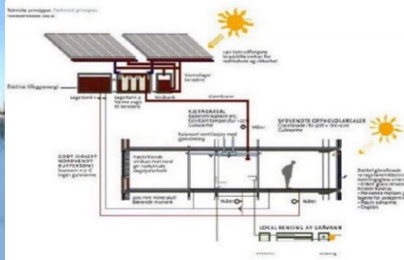


Figure 5: Solar panels on the roof, storage and transmission of energy to the building [11]

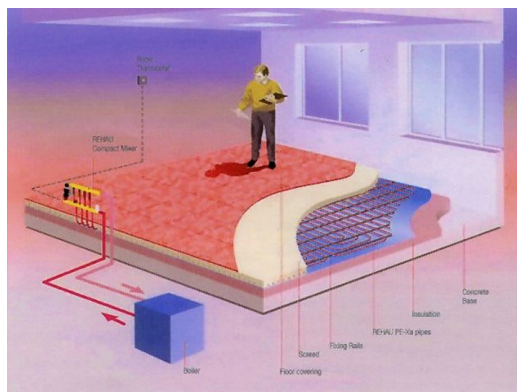


Figure 7: Small windows for natural ventilation [13]



Figure 8: Heating system installed in the floor [14]

6. GREEN ARCHITECTURE OF THE 21ST CENTURY

Many architects believe that the threats posed by skyscrapers are more serious than air pollution. To tackle the problem they propose green architecture. Lack of space and explosion of population is considered a serious threat to the environment. Skyscrapers and other mega structures built to balance between space and population growth consume considerable amount of energy both during the construction process and after it is

put into operation. They also produce sewage and pollution and generally deprive their dwellers of natural light and fresh air. Nevertheless many architects, engineers and designers believe that buildings in huge dense cities, if designed correctly and built, can be sign of green and sustainable development in architecture. According to this belief, adverse effect of unfavorable factors on the environment is alleviated [2].

Five top useful methods, proposed by noted scholars, to reduce adverse effect of mega structures on the environment are energy, light and air, being green, water and wasting it, and urban construction. In order to achieve these goals, structural design experts have begun to promote strategies that were common in the past and to modify them to huge, complicated buildings of today (e.g. air conditioning equipment and providing natural shade to lessen the heat in the building). In some time, designers have begun to adopt state of the art technologies such as powerful solar cells and wind turbines in order to build skyscrapers that both provide comfort for the dwellers and are friendly toward the environment.

7. MASDAR THE FIRST ZERO CARBON, ZERO WASTE CITY, UNIQUE EXAMPLE OF GREEN ARCHITECTURE

One of the exceptional projects in green architecture is a carbon free city with no pollutants in Abu Dhabi that is going to be designed by “Foster and Partners Co” (figure 10). The 1483 acre city of Masdar, inspired from Arabian cities, is surrounded by walls but the stone and mud walls of it will be covered by layers of Photovoltaics² with the capacity of the production of 130 megawatt (MW) electricity (figure 12). By methods like harnessing solar energy and applying building materials resistant to heat such as extra shades and floor cooling this project will be established on the territory of desert.



Figure 10: Masdar, The world’s first zero carbon, zero waste city [15]

Figure 9: University [15]



Figure 11: Transportation hub [15]

Figure 12: The first design of Masdar [15]

In the surrounding lands, 20 miles away from the center of Abu Dhabi, are located the Photovoltaics and wind power station, research centers and agricultural territories to provide the factories with fuel. The farms help reduce the waste by absorbing carbon alleviate the effect of gases emitted from the factories. The water waste of factories will be used to clean the city and supply it with water. The university will be opened in 2009 AD (figure 9). The point here, is not to be disappointed at the magnificence of such projects. We need to beware of the harms we have done to the natural resources of our land and how we have fallen behind world’s

² Photovoltaics (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect.

developments. This downward spiral trend must be stopped. We need to know that fossil fuel reduction is feasible with existing constructional technique and without dedication huge amounts money. We only need to design properly and thinks green (figure 11).

CONCLUSION

There are still many misunderstandings around the concept of sustainable architecture (aka green architecture). There should be precise guides for architects and designers to help them understand this concept. There are so many modern systems and technologies that no need is felt to new ones. But very few people has the knowledge to use these techniques properly. Thus, sustainable architecture must become a subject of frequent discussion in universities so that student can get access to valuable information and consequently we will have high quality architecture in the future. This new angle of view to architecture is based on some important points:

- Emphasis on quality
- Caring for the future
- Respecting the environment

Having good architecture is not enough to have sustainable architecture. It is also important to respect nature and have knowledge about habitat, topography, and climate and weather condition. Thus sustainable design is not a formal style inspired from a fleeting excitement, but has deep concept and meaning in its nature which is the union of human, nature and architecture. It is to say that human has to change the way it lines and stop excessive use of energy and cease polluting the water and air. If enough attention is given to all there, the next generation will not encounter the threats of air pollution and consequences global warming.

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