

A COMPARATIVE STUDY OF DESIGN PRINCIPLES IN THE ARCHITECTURAL STYLES ASSOCIATED WITH SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT

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ABSTRACT:

The main root of environmental and sustainable architecture movement dates back to the 19th century. Relying on technology and modern tools, despite its tremendous achievements, modernism struck fatal blow to the environment and faced humans with one of the most important problems. Environmental crisis and increase of human needs and demands of the environment are some of these problems. Considering the enormous and dangerous effects that man has on his environment, sustainability is one of the solutions to the increasingly growing needs. In this world, architects are also looking for new ways to ensure people have a desirable life and since strengths and weaknesses of a building design will affect the world's ecosystem as well, the critical task in this regard will be on charge of the architect. Discussions on topics of sustainable architecture (green architecture), organic architecture (ecologic), indigenous architecture (ecology-oriented), eco-tech architecture that was the context of prosperity and inspiration of the original architects indeed, emphasize on the concept of sustainability. The purpose of this paper is comparison of various architectural styles associated with sustainability and sustainable development and presenting their common characteristics. Data were gathered by documents (library) and by analysis – adaptive approach. The overall results of the study indicate that all these styles have the same concepts and lead to environmental-compatible architecture.

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INTRODUCTION

Nowadays, environmental crisis and human's increasing needs and demands of the environment and his expectations of them are of the major problems that people face. These expectations are now emerging from the interaction of four leading factors of increase in population, rising expectations of people, technology and technological progress and its impact on the environment and human behavior in relation to their environment [1].

The 70th decade A.D (the late modern architecture) can be called as decade of the environmental crises awareness. This crisis caused some reactions in the world including sustainable development and sustainability. Mean while, politicians in decision making position and industrialists in all areas in the position of enforcement and undertaking the role of fighting with the earth destruction have the greatest burden on the shoulders [2].

Due to the enormous and dangerous effects that man has had on his environment, sustainable architecture is a solution which is needed increasingly. In fact, sustainable architecture is one of the most important trends of contemporary architecture; a trend which is considered a rational response to the problems created in the industrial age. With the advent of the industrial revolution and the technological and technical progress in various

areas, indigenous architecture around the world was forgotten; the indigenous architecture that was based on nature and the environment and consistent with climate. Modern architecture, born of these revolutions, totally ignored the substrate forming the architecture. Construction is inevitable and progressing every day as other areas of development. Creating a space for decreasing consumption of non-renewable resources, decreasing development in natural environments, and also decreasing consumption of toxic materials damaging human and nature in construction industry are the main rules of sustainable structures. Observing these rules, while facilitating the development trend, rational use of natural resources, and proper management of construction, helps the environment preservation and reduces energy consumption as well [2].

Since architects and urban planners form the individual and collective life of human beings in this world, they also, consistent with other scientists, have been looking for new strategies to provide desirable human life and whereas the correct comprehension of these concepts and considering them will impact the global ecosystem, the critical task in this regard borne by the people and they carry heavy responsibility against the human and other organisms habitat. However, with regard to the issue that sustainable architecture and urban



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planning are not just a fashion or style, but a fast and critical reaction to the loss of organisms' habitat, they have pivotal position and role in education at all levels.

Discussions on topics of sustainable architecture (green architecture), organic architecture (ecological), indigenous architecture (ecology-oriented), eco-tech architecture that was the context of prosperity and inspiration of the original architects indeed, emphasize on the concept of sustainability. The purpose of this paper is comparison of various architectural styles associated with sustainability and sustainable development and presenting their common characteristics.

Definitions and terminology

Definition of Environment

Some major definitions of environment are as follows:

- The environment particularly material and immaterial impacts that influence growth and development and existence of a living organism [3]. All factors (biotic and a biotic) that actually affect an individual organism or a population at any point in the life cycle [4]. European Union defines environment as follows: "The composition of elements the complex relationships of which creates the place, the surrounding environment and living conditions of the community as they are, or felt." As a result, environment includes man-made environment, natural environment including air, land and water [5].

In fact, considering the environment and nature in our time has become standard; a criterion that every day becomes more and more pervasive in the world. In the environmental outlook, development is sustainable only when it is based on the foundational principles of ecology [6].

Ecology

The word "Ecology" is formed of two Greek words "eycus" which means housing, context or location, and "logos" which means knowledge or science and its literal meaning is "the review or study of organisms in their habitat [7].

Hegel in defining the term "ecology" in 1866 writes: "We mean by ecology the whole knowledge of natural economy, i.e. doing research in all relations of the animal, both with its organic environment and non-organic environment" [8]. Thus, studies on ecology take place in two separate but complementary parts: Study of characterization of the organisms' surrounding and their response to natural factors [7]. Ecology is combined study of the environment and organisms and to achieve this objective, i.e. the identification of organisms, their environment and relationships, it benefits from all scientific disciplines that independently study the environment and living organism [9].

Sustainable Development

Relying on technology and modern tools, despite its tremendous achievements, modernism struck fatal blow to the environment. These affairs gradually led to thoughts of reviewing process and procedures of modernism and sustainable development is one of them [10]. In a dynamic system like human society, sustainability essentially means stability and constancy over time. Consequently, this concept is not something that can be easily measured and tested, because it is a non-constant quality, not a fixed point [11].

By shift in development paradigm from classical to modern, sustainable development and environmental issues became main pillars of development. Meanwhile, awareness of the society about the importance of environmental issues in the context of sustainable development has been increased throughout the world. [12].

Development can be considered as life improvement and reaching the ideal level of development in the area of economic, social and cultural contexts that brings the realization of freedom, justice, social dynamics, human development and economic, social and cultural growth. Sustainable development is a discussable concept with a wide range of meanings. On an abstract and mental level, sustainability is related to preservation and or improvement of integrated natural systems which include the whole life on our planet. [13].

Sustainable development means steady, staying, lasting, static, fixed, permanent, perpetual, stable, firm, constant, secure, everlasting, eternal, durable, sustainable, progress, development, extension, expansion, growth and advent. In Farsi it is translated as stable, remaining, steadfast, enduring, durable, etc. In Dehkhoda dictionary, present meaning of sustainability, considered in this text, is what can be sustained in the future.

Sustainable development is a qualitative development and pays attention to life qualities that aim is to raise the quality of life for future generation. It has profound implications in three areas: environmental sustainability, economic sustainability and social sustainability. [13].

Sustainable development is development which causes every generation preserve water, air and land resources, so that the consumption of natural and environmental resources in the development process of the current generation do not reduce the possibility of consumption of these resources by future generations [14].

The philosophy of sustainable development is maintaining the right to choose and capacity of access to welfare, at least as the current generation, for future generations as well [15].

Despite the progress that suggests a new direction, development suggests sort of adaptability to what is now and continuity in the development



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which is called identity, and therefore it is distinguished from the progress concept.

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Among the definitions that are used in sustainable development there is a definition that was presented in Geneva and based on the following principles:

- In sustainable development the focus is on human. Humans in harmony with nature deserve a life associated with health and development.
- Development is a right which must cover the current and future generations equally.
- Environmental protection is an integral part of the development and cannot be considered separately.

The Brundtland Commission's definition of sustainable development is as follow: "Development that can meet the present needs without losing the ability of future generations to meet their needs". According to what was said, the concept of sustainable development means providing solutions vs. traditional, physical, social and economic patterns that could prevent problems such as destruction of resources and ecosystems and injustice prevalence, and low quality of life. To favor the awareness of the society on the path to sustainability or fields related to move toward sustainability, it is inevitably necessary to express sustainability indicators. The general concept of sustainable development has profound implications in three areas of: 1- Environmental Sustainability, 2- Economic Sustainability 3- Social Sustainability [16].

Four major commitments lie in the definition:

- "Prospect" means the induction of natural resources and cultural and scientific assets for future generations
- "Environment and Resources Preservation" for effective protection and management of all environmental resources
- "Equity" means a fair share and access to local and global resource and its use
- "General Partnership" means public participation and free access to information for better and faster solution of environmental issues. [9]. The main objective of sustainable development are listed as providing essential needs, improvement of living standards for all, better maintenance and management of ecosystems in a safer and happier future [18].

Sustainable Architecture

In this world, architects are also in line with other scientists to find new ways to provide desirable life for human and as strengths and weaknesses in a building will impact global ecosystem, the architects

bear a sensitive duty in this regard. The main roots of sustainable environment and architecture movement date back to the 19th century. Application of sustainability concepts in architecture has opened new issue called "sustainable architecture", "ecological architecture" "green architecture" or "environmental architecture" that all have the same concept and indicate the environment- adaptable architecture [19]. Speaking of sustainability in architecture can be interpreted as imagine and design of future construction, not only with physical sustainability of building but also with sustainability and preservation of the planet and its energy resources. Ecology of building is meant to focus on building capacity to integrate environment and atmosphere factors and convert them to spatial qualities of comfort and form. Sustainable building is a construction that has the least adverse impacts on the natural environment over the life of the building and regional and world establishment [10].

The principles which must be adhered in view of Brand and Robert Val (Table 1) so that a building can be categorized as an example of sustainable architecture are as follows:

Table 1: Sustainable architecture principles from view of Brando and Robert Val [20]

Principles	Sustainable architecture principles from view of Brando and Robert Val
Principle 1	Conserving Energy
Principle 2	Working with Climate
Principle 3	Minimizing new Recourses
Principle 4	Respect for Users
Principle 5	Respect for Site
Principle 6	Holism

Sustainable design is not a formal style and cannot be inferred from contemporary circumstances and impulses but there are profound implications in their heart which are bonding human, nature and architecture [10].

Three principles of strength, beauty and efficiency are principles proposed in Vitruvius and sustainable design is also aimed at honoring the three principles.

- Strength: resistance against forces for sustainability, sustainable materials, recyclability and reuse of the used materials
- Beauty: healing spirit and soul of consumers to be remained in the minds
- Efficiency: Sustainable Design as a flexible design must not lose its effectiveness in different conditions.

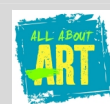
In summary, strategies and approaches of sustainable design include:

- Use of natural resource in buildings construction, façade making and furniture.
- The use of natural resources in lighting and ventilation in buildings.



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- Ongoing monitoring and management of mechanical systems of ventilation and air conditioning.
- Continuity and follow-up in internal monitoring of building and protection.
- Control and overlook of the building inhabitants in indoor light and natural ventilation, etc.
- The building is located in an area where air quality is excellent.
- The design of buildings so that indoor is not affected by air concentration [18].
- Use of façade and materials with suitable Albedo

Generally three principles arise for sustainability in architecture:

- Design based on lifecycle (Figure 1)
- Saving resources (Figure 2)
- Human design (Figure 3) [13].

Includes reduction, recycling and reuse of natural resources used in the building. Life cycle design introduces a method to analyze the building process and its impact on the natural environment. Each of these principles includes specific sets of strategies. Human oriented design focuses on the interaction between human and natural environment [21].

The following charts show three principles of sustainability in architecture and methods of this design:

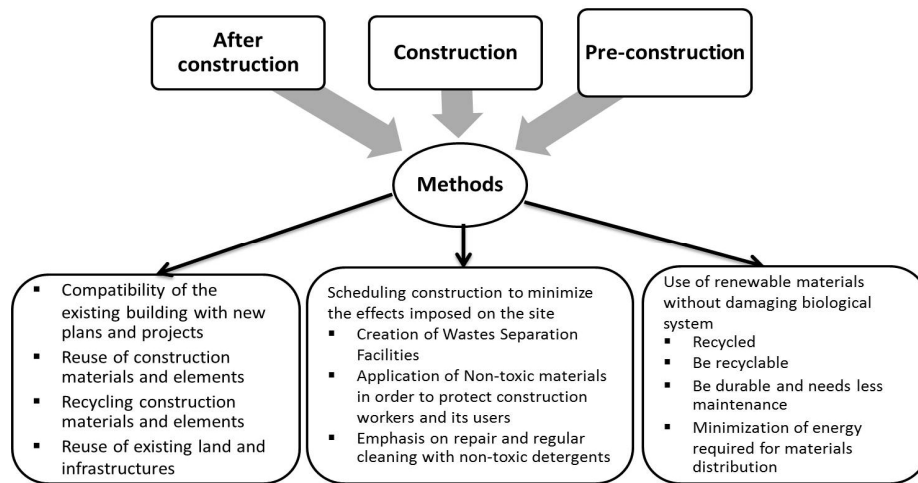


Figure 1: Methods of Design Based on Lifecycle, [13], Drawing: Author

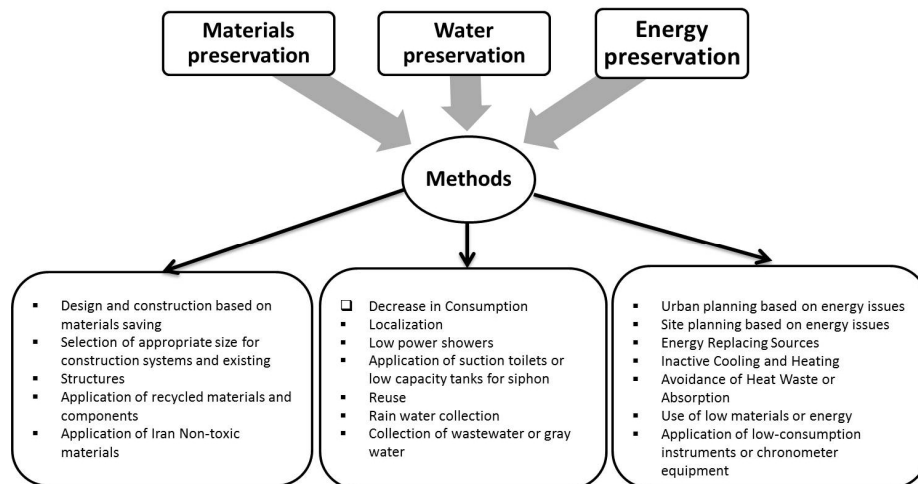


Figure 2: Design Methodology based on Saving Resources [13], Drawing: Author

Green architecture

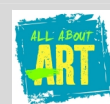
Green process in architecture is an old process, for example when cave man for the first time discovered that choosing a cave faced to south side from ambient temperature viewpoint is pretty much better than the cave opening to the north. The new subject that is important to be understood is that green architecture and man-made environments mean creating the best process for the design of

buildings; so that all source input of building, its materials, fuel and objects used by residents require a stable architecture. Many of the existing buildings own at least one of the numerous and recognizable features of green architecture. However, few of these buildings have the whole process altogether. Finding buildings that have all principles of green architecture is no easy task because green architecture is not yet fully understood. A green



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architecture should be included more than a single form of the urban environment. building of its plot and should be included a stable

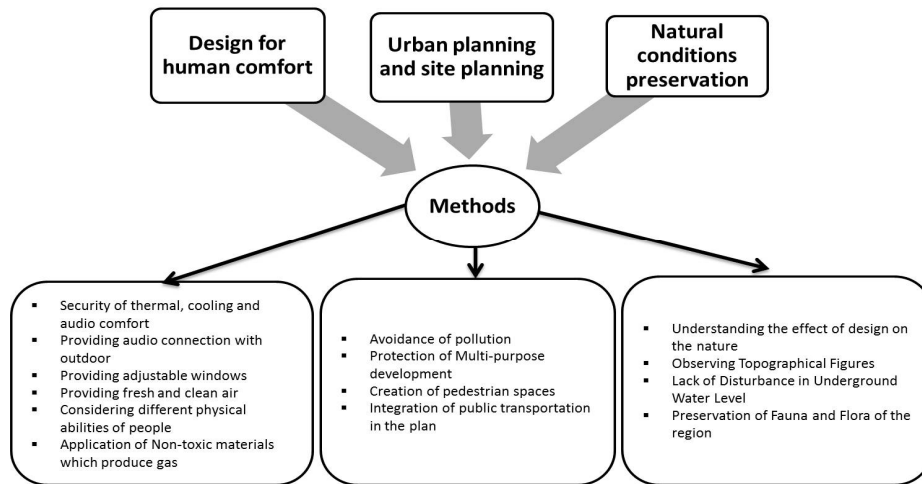


Figure 3: Human Design Methodology[13].Drawing: Author

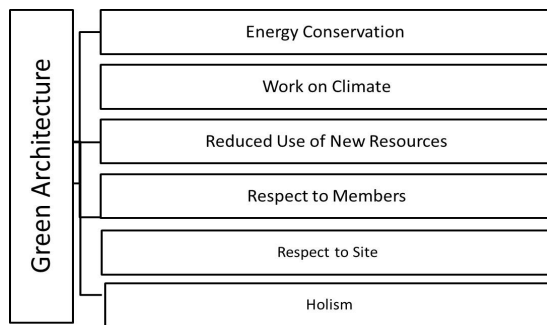


Figure 4: Principles of Green Architecture, Drawing and Analysis: Author

Ecologic architecture or organic architecture

In analogy with the concepts of biology that deals with the relationship between the components of living organisms with each other, and concerns the building itself as the modern architecture, ecology that is concerned with the interrelationship of organisms and their environment, pays attention to the role of the environment and external conditions on the quality of the building. Ecologic design focuses on the following items: [22].

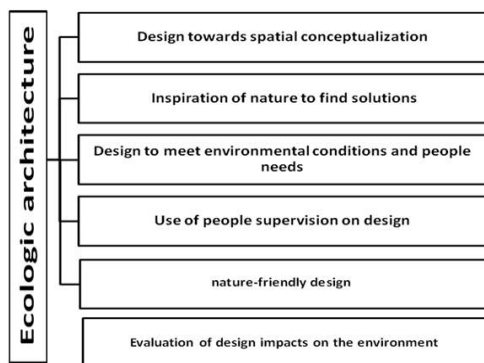


Figure 5: Principles of Ecologic Architecture [22]

Indigenous (Ecologic-Oriented) Architecture

Indigenous architecture means paving the nature to cope with accommodation needs by choosing and using facilities of every land. The process of formation of indigenous architecture can be considered based on the following five principles [23]:

Architectural design is one of sustainable architecture dimensions based on ecology principles and criteria. For making a biotic and organic architecture and appropriately meeting the needs of today's society, a depth review and understanding of traditional architecture can be used and then it can be translated into the contemporary language and expression [2].

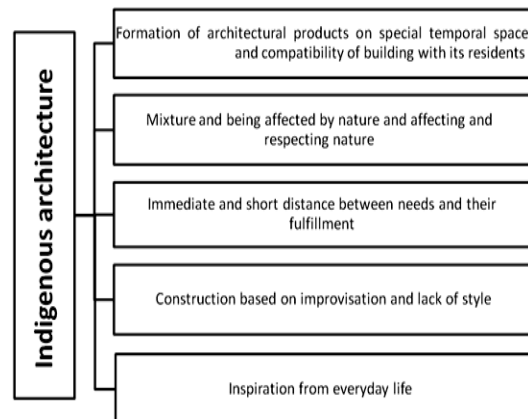


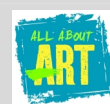
Figure 6: The process of formation of indigenous architecture [23].drawing and analysis: author

Echo-tech architecture

In this style, technology is not against nature but it is beside and parallel to nature in order for further exploitation of environmental facilities and security of human comfort. Echo-tech is created from words (Ecology + Technology). Principles of Echo-Tech Architecture can be seen in the table below: [24].



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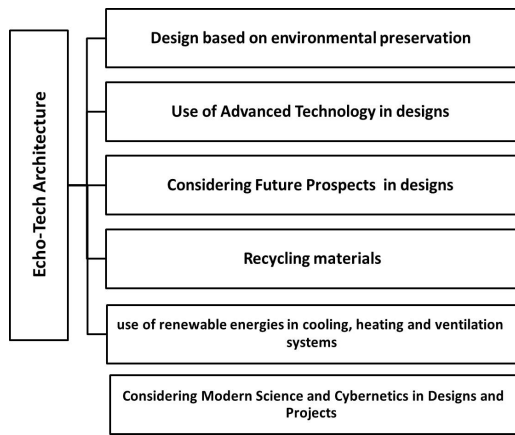


Figure 7: Principles of Echo-Tech Architecture, [24].drawing and analysis: author

According to above mentioned, architects in the world are also looking for new ways to ensure people have a good life and as the strengths and weaknesses of a building design will affect the world's ecosystem, the architects bear a critical task in this regard. Discussions on topics of sustainable architecture (green architecture), organic architecture (ecologic), indigenous architecture (ecology-oriented), eco-tech architecture that was the context of prosperity and inspiration of the original architects indeed, emphasize on the concept of sustainability. Architectural styles related to sustainability and sustainable development and their properties were studied. The overall results of the study indicate that all these styles have the same concepts and imply sustainable and eco-friendly architecture, energy preservation, etc. The following table shows those features and sustainable design specifications.

CONCLUSION

Table 2: Comparison of Different Architectural Styles in relation to Sustainability and Sustainable Development, Drawing and Compilation: Author

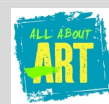
Architectural Style	Source of Inspiration	Features
Green Architecture	Energy crisis + threat of mankind's place on earth	Energy Conservation Work on Climate Reduced use of new resources Respect to Members Respect to site Holism
Ecological Architecture (Organic Architecture)	Nature + man-made construction	Understanding the relationship between biotic and a biotic components of nature Minimum interference in the natural environment Considering indigenous architecture Growth Development from inside to outside Showing Nature of Materials
Indigenous (Ecology-oriented) Architecture	Nature + Culture	buildings are compatible with people living in Mixture and respect to nature Immediate and short distance between needs and their fulfilment Construction based on improvisation and lack of style Inspiration from everyday life
Echo-Tech Architecture	Environment + Technology	Environmental Preservation Advanced Technology Future Prospects Recycling materials Renewable Energy Science Cybernetics

- Design Based on Life Cycle
- Saving Resources
- Human based Development
- Design of future constructions
- Sustainability and preserving the planet and its resources
- Focus on building capacity to integrate environment and atmosphere factors and convert them to spatial qualities of comfort and form .
- Energy preservation
- Coordination with climate
- Reducing the use of new sources of materials
- Satisfying needs of residents
- Coordination with Construction Site
- Holism
- Bonding Man, Nature and Architecture
- Strength: Resistance against the imposed forces for stability, sustainability
- Materials, recyclability and reuse of the used materials
- Beauty: healing spirit and soul of consumers to be remained stable in their minds
- Efficiency: sustainable Design as a flexible design
- Use of Natural Resources in the building construction, making facade and furniture
- The use of natural resources for lighting and ventilation in buildings.
- Continual Management and monitoring of mechanical systems of ventilation and air conditioning .
- Continuity and follow-up in internal monitoring of building and protection .
- Control and overlook of the building inhabitants in indoor light and natural ventilation, etc.
- The building is located in an area where air quality is excellent.
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