

Research Article

An Exploration on Ecologic Compatibility and Green Architecture Principles in Iranian Deserts

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Abstract: The purpose of this study is an Exploration on Ecologic Compatibility and Green Architecture Principles in Iranian Deserts. Disproportionate impact of human on the nature is not new. This disruption is a relatively recent phenomenon related to two chief factors, first, population growth and second, mastery of human over the nature. Since the Industrial Revolution excessive exploitation of the natural resources has been intensified. So, this causes a gradual depletion of natural resources and the imbalance of nature and eventually an uneven relationship between man and nature. Attempts need to be taken so that human be able to sustain life and the nature survival since a global ecological security, national and social safety are not even guaranteed. Respect for the environment and the nature as well as being familiar with the ecology, topography and weather sound critical. Accordingly, sustainable design is no longer a formal style inspired by the transient conditions, though it includes some deep concepts symbolizing man, the nature and architecture interaction. Benefiting from theoretical findings of green architecture and sustainable urban design principles besides traditional architecture and local urbanization in desert areas are manifested in the notion of Iranian desert city, instead of continuation of uncontrolled expansion and low-density cities, it is advised to take steps towards improving environmental sustainability.

Keywords: Desert, desert city, green architecture, sustainable development, urban designing

INTRODUCTION

The nature has been recognized as whole universe with entire events. Sometimes, it is founded on a series of causes and effects. However, the other descriptions of the nature such as the world of creatures are assigned to the nature. Disproportionate impact of human on the nature is not new. This disruption is a relatively recent phenomenon related to two chief factors. First, population growth and second, mastery of human over the nature. Since the Industrial Revolution excessive exploitation of the natural resources has been intensified. So, this causes a gradual depletion of natural resources and the imbalance of nature and eventually an uneven relationship between man and nature. Attempts need to be taken so that human be able to sustain life and the nature survival since a global ecological security, national and social safety are not even guaranteed. Respect for the environment and the nature as well as being familiar with the ecology, topography and whether sound critical.

According to the Brunt land Commission definition, the current definition has been considered from three aspects. One, from the human-orientation view, second, problem in describing needs and third, lack of providing practical scenarios to achieve it. Based on the International Union for Conservation of Nature definition 1991, improvement of man's life within the carrying capacity of supporting ecosystems

has been concentrated. This simple and process-orientation definition may suffice. Examining about fourthly environmental indexes in late 20th century by the UNESCO has indicated that the global economy due to crustal dwindling is no longer able to grow as easily as it was.

Increased production of food supplies does not proceed with the speed that is consistent with population growth. Thanks to restricted fossil and mineral resources it seems that human is urged to renew the new energies. Rapid increase of population growth causes resource depletion, environmental pollution and lower levels of man's life. The modern man having been encountered with a bulk of ecological problems like destruction of the ozone layer, green house effect, deforestation, desertification, increasing pollutions, depletion the natural resources, rising sea levels and so forth.

For more than three decades, the human relationship with the natural world has been irritating due to the occurrence of a wide range of environmental crises. Urban buildings designs all over the world have always destructed the environment (Judet, 2001).

Architecture and the environment: Architecture could devise some sort of compatibility with the environment. As a matter of fact, architecture has always been struggled to describe its own production

within the ecosystem. Actually, building is a part of the ecosystem that needs improvements. This is not a new approach that designers have to take into account how to close to the environment. Ideas which sometimes were idealistic or trivial now seem incredibly in accordance with needs and a wide range of environmental issues.

Many countries have reviewed their decisions on using energy properly adopting ecological standards in order to demonstrate their awareness (Mackenzie, 1991). Turning 21st century, new concepts have entered the realm of architecture and the environment. One such is *baubiologie*, a movement formed in 1970s in Germany. As the *baubiologie* pioneer, Professor Antony Schneider initiated the movement to contribute to designing buildings go hands in hands with the environmental health. So, it would be a strong driver for a good physical and spiritual movement is achieved due to ensures the least possible damage of materials. This process, therefore allows the building to breathe. According to Professor Schneider, the building is a live organism could be matching the environment via its permanent control and regulating the actions.

Architecture and ecology: The *baubiologie* at the same time that affects life style it also directly associates with how to deal with the environment, peoples' behavior and their life style rather than absolute technical assessment. The *baubiologie* is an interdisciplinary philosophy comprehensively considers architecture. It has initiated from 1960s in the Netherlands by the Green Movement. Currently, in Europe about 20% of new buildings are constructing on the basis of ecological architecture standards. Germany, Sweden and Norway are the pioneers.

In the *baubiologie*, the relationship between the nature and architecture, ecological considerations, environmental protection, environmental engineering, environmental psychology, environmental considerations in construction, recycled materials and energy, preventing from waste of energy, land use, taking into account the biological, ecological, economic and social conditions (Armaghan and Gorji, 2009). The objectives the *baubiologie* aims to achieve are as follows:

- Protecting energy
- Harmony with the environment
- Reduced usage of new materials
- Satisfying the human needs
- Caring about the God gift resources
- Mutual dependency of man, the nature and architecture

Architecture could function as a creator of conformity with the environment. As a matter of fact, architecture has always struggled to define its

production inside the ecosystem. So, buildings are a part of the ecosystem and move to strengthen and improve the environment. Respect or the nature is internalized as the prominent architecture like Frank Lloyd Wright was interested in the nature. The organic architecture is as old as the human civilization, though in spite of all its respect for the environment, the organic architecture cannot meet the man's every day needs. But what about a compatible architecture?

This type of architecture is observed by the observant. It is not, too, imposed on the nature. A sort of architecture interacts with ecosystem natural cycle and enjoys as much as it can from the available technologies and minimally use energy. The compatible architecture uses from the waste in order to improve the environment and is sensitive enough towards the nature. Also called harmonic architecture since this harmony is more intelligent and conscious compared with the organic architecture which has no solution for the wastes. Meanwhile, what may be neglected are the human identity and the environment. The 20th century reliance on uncontrolled technologies made the architecture as one of the big causes of ecological disturbance and creating of dangerous phenomena of fission ozone layer, green house effect and air pollution (Armaghan and Gorji, 2009).

The purpose of this study is an Exploration on Ecologic Compatibility and Green Architecture Principles in Iranian Deserts.

MATERIALS AND METHODS

Principle 1: Protecting the energy: Each building has to be designed and constructed in a way that it minimizes the need for fossil fuels. It is a definite creation was followed in past decades because of construction procedures. Though, due to huge diversity of new construction materials and technologies in the modern age, such principle has been forgotten. Thus, using different materials or a combination of them, buildings change the environment based on the user's needs.

Principle 2: Work with the environment: Building has to be designed so that is able to use local ecology and energy resources. The buildings direction and form as well as the location of interior spaces could take the shape to increase internal peace and at the same time the proper insulation minimizes consumption of fossil fuels. These two processes are overlapped.

The designing tradition regarding the local for creating some peace inside the building is not restricted to the heating rules. But in most local architects are demanded to design a cool space for creation of pleasant conditions in the building. The scenario now is using the air conditioning system, an inefficient solution dealing with the environment and simultaneously consumes much energy even though

when energy is inexpensive and available enough because of making environmental pollutions will be a wrong choice.

Principle 3: Reduced usage of the new resources: Each building must be designed that minimizes using the new resources as much as possible and finishing its useful life, it would become a resource for other building other constructions. This re-use of the old materials could occur in utilizing the recycled materials or spaces. In most cases access to new materials is limited; some procedures will be identified through them the buildings were constructed for specific purposes are reshaped for other purposes. Changing some old buildings for new applications can also cause new costs and problem. However, advantages of reutilizing the large buildings within the urban environment can cope with these problems. Renovation of existing buildings in big and small cities protects from using materials and reconstruction of the building, accordingly prevention from urban environment destruction.

Principle 4: Respect for users: All buildings are human products, in some buildings the presence of human is respected, though in few others steps are taken to deny any human presence. For a professional architect safety of building materials and processes is important is for workers or consumers to the same extent is for the whole human society. The other form of human participation which needs more consideration is positive engagement of users in the process of designing and construction if is neglected, an effective source will be lost.

Principle 5: Respect for the site: The Australian architect Glenn Murcutt claims that the building should touch the ground smoothly. The building which greedily consumes the energy will produce pollution and is alienated with the users. So, it never senses the ground softly. it is impossible to remove the building from the site it is operating and then revise the conditions before construction. Though in urban societies, the local and traditional life has been left behind and architects have entered. For creation of new applications like exhibitions and other cultural activities require some ongoing need for temporary structures (such constructs take the form of The Bedouins tent).

Principle 6: Holism: Entire principles of the green architecture demand for participation in a holistic process for creation of an artificial environment. Finding buildings have founded on the basis of the green architecture principles is not something easy since the green architecture has not been identified completely yet. A green architecture above designing a unit building has to include its own peace. Thus, it

should contain a sustainable form of the urban environment. City is something beyond constructed buildings. It is a set of systems are interacting together. Systems for living and pleasure have physical forms which a close look at these systems the future city image is recognized.

Following three specific principles by the green architecture: Understanding and study of these principles will assist the architect to obtain a deeper perception of the environment he is going to design.

Resources economy stage: This principle in one hand contributes to proper operation of renewable energies and resources such as fossil fuels in order to reduce energy consumption and on the other hand it takes seriously into account control and better use of natural resources as the renewable and sustainable energies.

The life cycle design: The second principle of sustainable architecture assumes that the material changes from one form to another without damaging the usefulness.

The human design stage: This principle is rooted in requirements for conserving of the ecosystem chain elements which they also assure human's survival. This principle includes three strategies of natural resources protection, urban designing and designing the site and human comfort.

RESULTS AND DISCUSSION

The central parts of Iran are covered with widespread desert area lengths thousands kilometers with 500 to 1500 m altitude above the sea level is fluctuating. This desert is one of the driest regions in the world which in summer becomes one of the hottest parts on the Earth. However, several Iranian historical cities lay Silk (4000 BC), Kerma, Yazd, Kashan and modern Tehran have been founded around the desert area (Beazley and Harversson, 1982).

The human inhabited in the desert area is impossible except an intelligent use of the natural resources and making the tough conditions more tolerable. Some problems which have stimulated the dry lands peoples to find genius solutions are the daily sun light (maximum temperature 40°C in summer), fluctuation of daily temperature in Yazd up to 20°, hot summers and cold winters (annual temperature fluctuation in Yazd city up to 59°), cool weather, little raining (annual ranging 60mm in Yazd city), draught and warm winds and sand streams (Tavasoli, 1973; Ministry of Housing and Urbanization, 1983).

The physical characteristics of desert textures: The physical characteristics of the desert textures in Iran are categories in different levels.

Structure: Using the aqueduct as one significant strategy to operate underwater and directing them toward residential and agricultural textures in a hierarchical form from the origin to agricultural lands, from the major river to the minor branches are the basis for formation of the path networks in the traditional textures. Accordingly, the most fundamental foundation of a city which is hidden is the water network. Therefore, water is the most critical element in locating and construction of living residents.

Compressed texture: Traditional cities of the desert areas in Iran are chiefly made of two compressed and connected textures. The recent studies have indicated that the concept of sustainable city associates with compression concepts meaningfully. As providing environmental peace and energy economy occurs only through reducing the surfaces of urban building and textures are exposed to sun light via making them compressed (Golkar, 1997). This principle is observable in body texture of Iranian desert cities through compressed buildings in a way that some of residential units are connected to other units from four directions.

The greenbelt: The compressed texture of green belt consists mostly of fruit orchards and surrounded by farm fields as measures of ecosystem. Thus reflecting the sun's heat, causing a sharp rise in the temperature of the soil is minimized. Greenbelt surrounding the city has a central role in protecting the central texture against desert winds, dust and dry desert air considered as one of the most important factors in the natural ventilation (natural and artificial ecosystem in a macro level).

Rganic order: In desert cities classification of road network, segmentation of the ground and organizing empty spaces follow two different methods. The road network with organic and hierarchical order according to inclination and subterranean waters have been created, though the segmentation of land and buildings are made with irregular geometric order (due to climate) (Ghaffari *et al.*, 2002).

Presence of such indirect pathways, the maze of alleys and transitions and indoor (sabat), in one hand excludes wind was troublesome and on the other hand due to its extreme depth provides maximum shade. The distinguishing feature of sunshade placement in the desert, which is one of prominent characteristics of desert cities, brings walking man on the path in shadow environment puts a proper sequence.

In many tents, some houses entrance makes a complex is important because of the sense of neighborhood and solidarity. Centrality, hierarchy and respect for privacy and social areas, have been obtained due to such urbanization that in turn have greatly contributed to the social sustainability of desert cities.

Studies by Golani (1995) on urban architecture and designing have shown that local architecture of Middle East traditional cities had founded in a considerable harmony and conformity with features of the region.

Givoni (1988) believe that the most principal outcome of urban designing in dry lands is "reducing stress caused by climate on individuals" live in outdoor areas for work, sports, walking and shopping. The second purpose of urban designing is empowering building to provide interior spaces in a way that besides creating a climate comfort it requires minimum use of energy. Generally speaking, stress in outdoor spaces of desert areas experienced by human is classified in four categories:

- Stress caused by high temperature in summer days raised from temperature and extreme sun light
- Annoying glare caused by direct or indirect solar radiation
- Expansion of dusty winds mainly in the afternoon
- Cold winds during the winter

Harmony with sustainable urban designing requirements in desert: Having a modern urban design implies that in order to reduce rate of stress caused by extreme heat in summer days it is mandatory that residential spaces are constructed to reduce walking and play spaces. Sidewalks must be located in shadow created by other buildings or trees. Shadows especially in places children are playing during the day in outdoor spaces seem crucial. Considering the special distribution of shopping spaces, schools and urban services, it is required that some basic services are designed near residential units. Furthermore, for managing micro-climates of urban spaces, buildings in arid regions should be designed so that shadows are made for walking tracks, playing gyms as well as proper air ventilation, decrease of dust and reduction of annoying light reflection.

Exploration of Iranian desert cities like Yazd, Kerma and Kashan indicates that physical properties of historical parts are considerably in accordance with the new scientific findings. It appears that this ecological comfort is an outcome of a lengthy trial-error process within the hosiery. Overall, according to physical features shared by the traditional cities, this could introduce the Iranian desert city pattern.

This pattern, thus not complies only with the principles of sustainable architecture but it also is consistent with the three principles of sustainable urban design. An efficient urban design responds to three "energy economy", "preserving natural resource" and "recycling existing buildings, textures and infrastructures" principles. With regard to the sustainable urban design three principles become important in interpreting desert cities.

Energy economy: In the Iranian desert city pattern the saving energy economy in different ways has been a

criterion. Such methods could be observed in “city form”, “city structure” and “inactive equipments”. In desert cities the city form either in typological view or combination and distribution of different application view, the energy would be saved. For example, in traditional neighborhoods like Fahadian in Yazd city, due to integration of available equipment at central neighborhood, a mixture of residential, business, health and educational applications, unlike the new cities residents do not go to long city travels, so the energy is saved. The “buildings shape” also is created in harmony with the climates that contribute to reduction of energy consumption to be used in heating and cooling of the buildings.

To provide climate comfort in aired places three elements of shadow and wind, water and minimizing the effect of sunlight are efficient (Kriken, 1983). Study of Iranian desert cities demonstrates that all three methods have been applicable. Making shadow by the residential units adopting some strategies like using central yards with high side walls and much centrality are created. Also, thin organic pass ways and their walls have created sufficient shadow in urban spaces. “Water” as a critical element plays an important role in desert cities. Water not only changes desert areas to living places, in an urban scale it has a fundamental role in city structures through hidden aqueducts and obvious rivers. In building scale though some elements like ponds, water assists to natural cooling and so lessens draught.

The next strategy for supplying climate comfort and energy saving is reduction of surfaces are exposed to sun light on city buildings and textures. This therefore is created via “compression” procedure. Generally speaking, compression is described differently and the compression scale is ratio of surface exposed to natural conditions to covered surface (the under building surface). In other words, a small one story building located at center of a land has the least possible compression, though if it is a larger two story building, more compression could be observed. Since although the under surface area is doubled, the surface is exposed to sun light and climate changes will be less than twice. This principle in physical structure of Iranian desert cities is identifiable through compressing houses in a way that some units are connected together. A few instances of interlocking roofs of the urban blocks could be found in desert cities.

The third common method in desert cities architecture is attention given to saving energy using passive systems. Some equipments like wind towers, “water reservoirs”, “glaciers” and “wind and water mills” in desert cities present residents services electrical instruments like cooler, an water cooler while consume energy with a lower cost. Besides, Haroon and Roof studies about technical-service buildings in local architecture of Iran have efficiently represented these effective equipments.

Protecting natural resources: Constructing buildings urban textures in desert cities of Iran proceeded so that they cause the least possible damage to worthy natural resources like land, vegetation and water. Compressed desert cities of Iran in spite of their modern cousins have absorbed more population in a smaller surface and consequently the surroundings lands especially agricultural lands remain undamaged. Moreover, the type of building materials such as bricks are mainly made of dirt in the construction site and in combination with other materials including straw are used in construction operations. These materials are all supplied from the local regions which Professor Pirnia calls it “ecology provided” and knows it as one of principles of traditional architecture of desert cities.

Recycling buildings, textures and urban infrastructures: Recycling and re-operating buildings is the other prominent feature of Iranian urbanization process (Golkar, 1997). During history even in periods many great socio-cultural transformations were happening was obvious. For example, after Islam prevailed in Iran, religious buildings such as fire temples were redesigned and used as a mosque. In recent historical periods also such process continues when residential units were left for the next generation after incessant restoration and maintenance. In some other examples some generations lived in one house. In other words, a respectful tradition in historical architecture and urbanization was maintained, restoration and reusing the buildings. This norm was in contrast with the modern culture which destroy the old buildings reasoning they are “too old to be used” and replace them with newer constructs.

CONCLUSION

The traditional desert cities like other Iranian cities have encountered with lots of extreme physical transformation are obviously different from historical and gradual changes of these organic residents. From the early 4th century AH, an inefficient modernization that mainly focused on making transformations and modernizing the physical appearance of cities have caused several fundamental transformation in Iranian cities. This physical modernization has been manifested within different stages of the Development Act 1933 and preparation of a comprehensive scheme for the urban design from 1941 on have created a basic transformation in the “Iranian desert city” pattern. However, some of consequences are created as a result of physical interferences in desert cities which challenge requirements of sustainable environment and sustainable urban design are listed below.

Examining the modern physical interferences I desert cities indicates that such transformations are in an apparent contrast with the essential agreement of

three sustainable urban design principles. The created physical transformations in cities show that the desired plan pay little attention to characteristics of local architecture and urbanization as well as natural properties. consequently, implementation of the comprehensive plans are mainly in form of road network, land use and density within last decades, the spatial-physical organization of cities have considerably lost their conformity with the environment, for example, the uncontrolled expansion of cities in one hand and is because of huge constructions an on the hand because of execution of the comprehensive plans. Today, desert cities are in unpleasant condition in terms of "population density". According to the available documents in 2006, the gross density of population of some desert cities like Yazd was recorded 39 per acre, Semnan 21 per acre, Kashan 45 per acre and Kerman 52 per acre (Ministry of Housing and Urbanization, 2009). This low gross density of pollution is recognized in form of development of lands within urban areas is an providential index of incorrect operation of land and infrastructures and as a result damaging the natural resources.

The greenbelt or the sustainable architecture is still misunderstood. However, there are many guidelines to assist architects and designers in order to gain a better perception of these concepts. To create a sustainable architecture having a good architect is necessary but not sufficient. Respect for the environment and being familiar with the habitat, topography and the climates is also critical. Therefore, sustainable designing is not a formal style is derived from the transient conditions. But it carries some deep concepts which are man, the nature and architecture interaction. As a matter of fact, what matters here is man needs to change his life style and avoids from excessive use of energy and polluting climates. All of these thus mean applying a sustainable architecture. If this is neglected the next generations will face with the risk of air pollution and global warming.

Furthermore, a critical review of conformity with ecology in architecture in addition to a study on physical boy of Iranian desert cities was presented. So, some theoretical bases relevant to the environment, green architecture, protecting the nature, sustainable development issues besides physical characteristics were provided. Moreover, the theory of desert city was introduced and the Iranian desert city pattern was recognized. Then, through comparing the consequences caused by uncontrolled expansion of desert cities with hidden principles in the Iranian desert city pattern, lack of any conformity between physical changes of modern cities with the principles of sustainable urban design was highlighted.

Benefitting from either theoretical findings or principles of sustainable urban design besides local

architecture and urbanization of desert areas of Iran manifested in the Iranian desert city pattern, it seems that instead of an uncontrolled and low density expansion of cities, some steps have to be taken for improvement of environmental sustainability in form of three strategic procedures as follows:

- Reconstruction, regeneration and reproduction of textures in the central add old city districts, especially due to the decay of physical body that are increasingly faced with declining environmental quality.
- Reformation of available textures in the surrounding neighborhoods to comply them with sustainable urban design principles.
- Using the opportunity of renewal of new neighborhoods, as the vehicle for benefiting from better standards of design for ecological requirements and conformity with sustainable urban design.

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