Sustainable Models in Arid Regions Architecture and Its Comparison with Modern Models—Case Study: Yazd City

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ABSTRACT

Sustainable design refers to presenting some solutions instead of traditional structural, social and economic development models such that it can prevent from emergence of some issues like disappearance of natural resources, destruction of ecosystems, pollution, rapid population increase, increase in injustice and low life quality. In today's world, architectures also seek new solutions for satisfaction of a high-quality life. It is obvious that life, work, recreation and relaxation are all activities which are done in spaces designed by architectures and because a building's weak points/strengths have direct impacts on global ecosystem, architects have sensitive roles in this regard. Traditional Iranian architecture has valuable principles and rules which are used in perfect architecture and makes it sustainable. The present research investigates sustainable architecture and Yazd local architecture as a sample of arid region architecture. Then, architecture and urban planning models in Yazd are investigated and compared with modern models.

KEYWORDS: sustainable architecture models, modern architecture models, traditional architecture of arid cities, Yazd

INTRODUCTION

An analysis of principles of design and elements of Iranian traditional cities reveals that these cities have been designed based on people's culture. Traditional values have not changed in modern era but architects and designers ignore them. Since urban design aims to create a human and favorable atmosphere, these principles should be investigated. Principles and methods of design are sustainable and may apply to creation of a social and cultural identity in modern cities. For many modern architects and urban designers who live in a new city like Shoushtar, looking back means a primitive and simple life but for many people who support substitute architecture, cultural identity is the main factor.

Furthermore, a comparison of local traditional architecture which is consistent with local weather which is usually seen in traditional section of cities with newly-born areas which are usually around these cities reveals that architecture in arid cities has gone far away from its natural and favorable state. This necessitates search for solutions to confront with this inappropriate and unwanted trend and correction of unwanted results of new architecture such that urban sustainable devilment is facilitated (Golkar, 2000:44).

Iranian traditional architecture has valuable principles which are used in proper architecture design and makes it sustainable. The present research investigates sustainable architecture and Yazd local architecture as a sample of arid region architecture. Then, architecture and urban planning models in Yazd are investigated and compared with modern models.

Statement of problem

In order to better understand architecture concept, it is necessary to present a clear definition for sustainable development concept. There are many definitions for sustainable development concept. A common definition for sustainable development is the definition presented in Bruntland report. It defines sustainable development as a development which satisfies the needs of the present generation without ignoring the abilities of future generations (Golkar, 2000: 45).

Sustainable design refers to presenting some solutions instead of traditional structural, social and economic development models such that it can prevent from emergence of some issues like disappearance of natural resources, destruction of ecosystems, pollution, rapid population increase, increase in injustice and low life quality. Sustainable development is a process in which economic, financial, commercial, energy, agricultural, and industrial policies are made in a way that they lead to a social, economic, and ecologic development. It involves enough investment in the field of education, hygiene, population and energy such that there will be no social problem for future generations. The main target of sustainable development is to satisfy basic needs, improve and promote life quality level for all and better administration of ecosystems and a safer future.

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The verb sustain comes from the Latin root and is made up of two sections which means upward which means maintain and protection. It has been used in English language since 1290 A.D. (Azerbayjani, 2003: 351).

In today's world, architects also seek new solutions for satisfaction of a high-quality life. It is obvious that life, work, recreation and relaxation are all activities which are done in spaces designed by architectures and because a building's weak points/strengths have direct impacts on global ecosystem, architects have sensitive roles in this regard.

At present, there is a widespread literature on principles and necessities of sustainable development and the role of architecture in it. Thus, dealing with all literature is not possible in the framework of this paper. Some theorists believe that environmental sustainability in architects' work area is explained by means of the following goals:

- Reduction in consumption of non-renewable resources
- Development in natural environment
- Elimination or reduction in consumption of nature-harming materials in construction industry

Sustainable development regarding constructional and environmental activities is usually called sustainable construction. Construction is one of the greatest economic and social sectors in Europe and has significant role in natural environment. Construction and environment are two key areas in global sustainable development (Gorji Mahalbani, 2010: 93). Thus, environmental sustainability has the following targets: minimization of non-renewable resources consumption, promotion of natural environment conditions and minimization of ecological harms to environment.

Explanation of a more balanced relationship between architecture and environment is the target of sustainable development (Zandiyeh, Parvardi Nejad, 2010: 5). Sustainable architecture is a process which can be repeated. Sustainability is a concept which is mostly used as value size of a method.

Therefore, sustainable development pays attention both to the process and final product. Sustainable architecture recognizes that the final product may wear away as time goes by or it might require substitution. However, it also recognizes a process which is durable and the process may be repeated or renewed, without unnecessary harms to environment and resources (Armaghan, Gorji Mahlabani, 2009: 23).

Situation

Yazd Province has an area of 131551 square kilometers and is situated in Central Iranian plateau and is neighbor to Kerman, Khorasan, Isfahan and Fars provinces. It is situated in north-to-south high ways and has a special position.

Yazd City has an area about 2397 square kilometers and is situated in an arid valley between SHirkouh mountain ranges and Kharaeqhit is neighbor with Bafgh city from east, Taft City from western south and Fars province and Isfahan province from west. This city is made up of two sections: center and Zarch. Zarch is composed of Yazd, Hamidiyyeh, SHahediyyeh and villages like Fajr, Fahraj, Allah Abad, and Muhammad Abad. This city has an elevation of 1200 meters above sea level and has an arid weather with hot dry summers and cold harsh winters. Yazd had a population of 374781 people in 1996. 90% lived in city and 10% lived in villages. In the past, Yazd city was the center of main administrative region of Yazd and was a part of Isfahan Province. Before that, Yazd was a part of Fars province. This city is situated in 31°54′15" northern latitude and 54°24′45" eastern longitude in the center of central area (Kalantari, Hataminejad, 2006: 7).

Figure 1. Yazd urban texture: Yazd Province Tourism guide, authored by Muhammad Reza Seyyed Hoseini

"Yazd is situated on Yazd-Ardakan plain and is bounded by scattered mountains of "Kharaeqhi" from east and eastern north, Shirkouh Mountain Range in west and western south and Siahkouh desert in north (Seyyed Hoseini, 2002: 5).

City and climate are two manmade and natural systems which have mutual interactions. Climate, up to where it has a relationship with human comfort is the consequence of factors like sunlight, temperature and air moisture, wind and precipitation. Climate of every geographical location has special appropriate conditions which has some restrictions regarding urban design. It is necessary to consider city climate and observe climatological regulations in designing different urban spaces like constructions, greenery, roads and so on. In addition to paying attention to performance, visual and aesthetic features.
Sustainable models in Yazd architecture

- Urban positioning: the first principle considered in building arid cities is orientation. Orientation of constructions and passages considers hot sunlight in summer afternoons and warm winds and is directed northern-south with some deviation. Therefore, buildings are built in eastern south-western direction.

- Use of materials with high thermal capacity which are resistant to heat in central Iranian arid plateau can be effective in comfort. Construction of mud-based and brick-based buildings in this area can be related to the climate. Mud and its derivatives have high thermal capacity and reflect a lot of sunlight and therefore buildings are kept warm in winters and cool in summers.

- Urban spatial structure: in Yazd, buildings and houses are faced to south and south east. This direction receives the lowest heat in summer and highest heat in winter. Use of natural energy resources like wind and sunlight is very common in traditional arid Iranian cities. Proper orientation for appropriate use of natural energies is an important principle in traditional cities. In most arid cities in Iran, buildings are faced to south east. This proper orientation protects residents against direct sunlight as well as preventing from unwanted winds harms.

- Urban texture model: climate is an important factor which has influenced morphology of traditional cities in arid Iranian areas. In this climate, cities have compressed textures and buildings have inter-attached walls and their limits are not recognizable. The second principle in considering sustainability in central Iranian cities is formation of compressive textures for preventing from severe heat and cold penetration in summer and winter and unfavorable winds into buildings.

- Models in passages: passages are indirect, bendy and covered in order to protect passengers. These passages prevent from penetration of unwanted winds and provide shade. Thin and restricted alleys facilitate movement between building blocks and high walls of houses which bound alleys provide shade and protect individuals from sunlight in warm summers.

- District orientation: urban districts are formed by a collection of residential and non-residential blocks with linking paths and other urban elements for life. In the past, each district had its own center hub and formed according to social and economic status of residents. The center hub of a district contained different elements like bazar, bathroom, water storage, square, mosque and so on and it was the center for linking several junctions and passages.

- Making economy in energy consumption using non-active systems. Use of elements like wind protector for appropriate use of wind in buildings, use of Sardab for providing necessary water for buildings and … are elements which cause a harmony between buildings and climate and maximum use of buildings from renewable energies and increasing building lifetime. Small and large wind protectors on top of buildings are important features of central Iranian plateau cities. Wind protectors transfer fresh air flow into rooms and propel polluted and warm air out of the rooms and do ventilation work. Wind protectors are directed towards winds and are usually high enough. Wind protectors actually absorb and direct wind to summer part of house for creation of a cool weather and its ventilation and absorption of warm and polluted air and pushing it out of the rooms.
Internal consideration and central yard: organizing main spaces around central yard and position of main spaces in a higher level
- Cellar ventilation is provided very easily from yard and prediction of external space and direction of sleeping and relaxing. Distribution of main spaces based on geographical status and climatic features which involves position of winter part in northern front for using sunlight in daylight and summer section in southern front for protection against sunlight. The yard is usually in the form of garden pit and creates cool spaces in cellar and uses air flow effectively.
- Use of greenery and water in urban spaces and building life like use of garden and water pit which moderates weather and lowers temperature as a result of attraction of sunlight, increasing moisture, shade, reduction in heat reflection by earth and creation of a residential environment.

Models and principles of modern design in Yazd
- Urban development in northern-southern and eastern-western direction, urban networks in chess-like manner.
- Ignorance of necessary separation in residential regions and transport paths
- Margin of main passages and streets like modern district center hubs
- Modern squares as urban symbols
- Personal design ideas disturbs city image and disrupts urban identity.
- Network-like urban design and block buildings and wide streets without considering climatic features
- Open urban texture and direct passages and streets in column-like and row-like form
- Access with car is the main bases of design and private alleys turn into ordinary streets
- Difference between private and public area has low meaning
- Wrong evaluation or displacement of public and semi-private social functions
- Use of green spaces as design instrument
- Design of open space in the form of square:
  a. Without effective elements
  b. Building as an effective element
  - Security idea in religious spaces
  - Tall house walls as a protector against climatic conditions in modern pedestrian passages
  - Trees for improvement of local weather. Pre-built construction materials for modern housing
  - Pavement of alleys with local construction materials in order to create harmony with environment
  - Absence of cultural harmony in buildings faces
  - Apartment units as the dominant housing form
  - Ceilings without any particular form or function
  - Ordinary brick as a natural decorating element for internal faces
  - Modern construction rocks in external faces of buildings

Problems regarding new districts design in Yazd
These include absence of considering local values present in old buildings of the city, copying non-local designs, absence of observation of appropriate scale for building open and green spaces, visual abnormalities and architecture features resulted from inharmonious relationship with natural features, widespread increase in artificial environments and reduction in greenery, absence of harmony for neighboring buildings height, absence of harmony between buildings heights and width of passages, use of different materials with contradicting features in building external walls, similarity between urban planning rules in different climates, absence of use of appropriate greenery regarding climate in buildings, failure to pay attention to use of historical textures, use of non-renewable energies for buildings.
Conclusion

Today, may commentators have learnt about negative points of interventions which do not consider traditional architecture and urban textures can be saved from disappearance by considering the forgotten points which were referred to in this paper. Consideration of the recommendations in arid regions can help implement sustainable development and return the identity of cities. Since arid regions have specific climatic features, residences in such regions should follow specific principles so that they can resist against such climatic features. Traditional villages and cities of Iranian arid regions have been also built based on these models and principles and appropriate to climatic conditions. Yazd city has also followed these principles and we investigated them in this paper. These principles include positioning, orientation, bordering of orchards and buildings, compressed textures for minimization of open surfaces and creation of thin alleys with too many bends and shade for passengers comfort. These were large-scale features. In building scale, architects used features for improving personal comfort for buildings residents. A comparison reveals that traditional architecture in arid regions is completely consistent with sustainable architecture design. However, such cities have been affected largely by physical changes within the past three decades and have used modern methods. Emergence of modern design without thinking like widening passages and construction of urban apartment complexes has had much harm. Features like green belt in margin of the city, proper orientation of buildings regarding sunlight and prevention from entrance of unwanted wind into buildings and creation of spaces called summer room and winter room, compression and continuity of urban texture, presence of indirect and bendy and covered passages for protection of passengers, internal design of houses using central yard, garden pit, creation of water storages and planting trees for building favorable weather in arid areas of the building, and husbandry in energy consumption and utilization of elements like wind protector, water storage and proper use of materials with high thermal capacity and light colors indicate a sustainable and original architecture in Yazd City and this shows that architecture in traditional cities in desert like Yazd City has been consistent with climatic features and nature.

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