

An Analysis to Implications of Sustainability in Physical Structure of Abyaneh Village

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ABSTRACT

Sustainable architecture, as a general term, describes environmentally conscious design techniques derived from an energy and ecologically conscious approach to the design of the built environment. Vernacular architecture of each region has always tended to respond to climatic conditions of the region using passive, low-energy strategies to facilitate human comfort. These strategies have always been integral to the form, orientation and materiality of the buildings, as well as demonstrating an economical use of local construction materials.

In Iran, vernacular architecture has been very important during history, trying to find a proper answer according to climatic and environmental conditions of each area. The construction strategies have been employed in adaptation with climatic conditions of each region leading to reduction of energy consumption and sustainability.

In this research, principles of sustainability in Iranian traditional and vernacular architecture have been discussed emphasizing of Abyaneh village which is considered one of the best examples of adaptation to nature and sustainability.

KEYWORDS: Iran; Vernacular Architecture; Climatic Techniques; Sustainability.

INTRODUCTION

In recent decades, the increase of population on the Earth has attracted dramatic attention to the 'Sustainability' concept. Therefore, the concept has turned into a broad area embracing different levels of human activities and knowledge considering three major principles of: Environment, Economy, and Society. Hence, in building and urban sector, it intends all levels of design and construction procedure to reduce the negative impacts of built environments on eco-system (weather, land, water, energy, and resource consumption) [1]. Sustainable architecture and designing compatible to environment is one of the main issues in design world today. It is probable that the aim of this designing is reduction of environmental damages and energy resources consumption and adjustment to nature [2]. Additionally, Sustainable architecture is a general term that describes environmentally conscious design techniques in the field of architecture; an energy and ecologically conscious approach to the design of the built environment. Vernacular architecture tends to respond to climatic conditions often using passive, low-energy strategies to provide for human comfort, strategies that are integral to the form, orientation and materiality of the buildings, as well as demonstrating an economical use of local building resources. It is therefore an ideal source for sustainable design ideas [3]. So, vernacular architecture could be classified as a very close type to the sustainable architecture because of being in harmony with nature, using local and green materials, natural ventilation, passive cooling and heating systems and its normative and indigenous evolution. As a matter of fact, vernacular architecture is a kind of an evolutionary architecture. There has been always a feedback as a driving force from the public that affected the architecture towards a vernacular and evolutionary type in the past. Moreover vernacular architecture has responded to the climatic conditions in order to provide the suitable environmental comfort for human live. Climate as a strong factor shaping the vernacular architecture has faced with many changes in the history of architecture. Some of the changes have been as shocks to the human life and affected the vernacular architecture seriously changing the buildings type and influencing the evolutionary trend of the development in the architecture basically so that causing total changes. Hence changes of architecture type should be evolutionary and in harmony with climate change; Correlation between those changes is a necessity otherwise architecture gets far from nature and sustainability [4].

In Iran, vernacular architecture is considered because of its hot and dry climate, trying to find a proper answer according to this condition has developed over many years. Scarcity of wood and stone building, extremes of temperature emphasize in response to the Iranian Plateau's arid climate [5]. The lack of natural resources make attention to preserve sun-dried bricks, there to keeping the remains is respecting to its cultural mood and having them by the most optimum of today's technology make the pedigree of Iranian ancient people more clear [5].

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This paper focuses on the importance of learning 'lessons from the past', and their incorporation into design solutions and emphasizes on the need for exploration of design and construction alternatives that are associated with local traditions. Abyaneh is one of most well-known historical villages of Iran. Its special and unique architecture originated from the principles of vernacular architecture of that region that plays an important role in sustainability of the village. So in this paper we intend to investigate physical and spatial characteristics of Abyaneh village from sustainability perspective.

MATERIALS AND METHODS

Different groups of theoretical and filed studies have shown that the issues related to sustainability can affect all aspects of human life especially in urban and rural settlements. These studies raised question among the policy makers, scholars as well as designers about the effectiveness of sustainable approaches to human activities including architecture. Most studies in the past tended to focus on the issues related to energy consumption regarding development and construction industry in developing countries, but there is still lack of conclusive studies on how the sustainable architecture methods and techniques of past can be revitalized to help people access the desired level of sustainability.

In this research, theoretical principles of sustainable architecture and climatic techniques of architecture and construction in traditional architecture of Iran have been specifically studied. The scientific information of this paper was obtained from scientific sources by documentary method. In order to collect and, analyze the information about Abyaneh village systematic observations have been suitable method in this research.

Vernacular Architecture in Iran

In Iran, vernacular architecture is considered because of its hot and dry climate, trying to find a proper answer according to this condition has developed over many years. Scarcity of wood and stone buildings, extremes of temperature emphasize in response to the Iranian Plateau's arid climate [5]. Iran's traditional architecture is designed in proportion to its climatic conditions, and more than often, the unique fabled artistic background of Persia makes up for the seemingly lack of natural resources and beauty [6]. In the past time, huge inheritances of enchanting and often beautiful vernacular buildings are survived in Iran Plateau. Mainly, many took place in the villages, but others had their grand counterparts in towns. In fact, we can see some of them as prototypes buildings in such places and even elsewhere [5]. Many researches were done during this period to investigate and categorize thorough these buildings, meanwhile many of visitors or even Iranians have cooperating to keep most of them as common places, but the fact is, having this artistic treasure shows the wealth of vernacular architecture and needs the prior attention [5]. Study of these buildings, motivates some instructive skills and cultural values in which the Iranians surpass: a) First, the design and execution of domes and vaults in mud-brick, which result in beautiful buildings, often constructed for mundane purposes. b) Secondly, the Persian imagination and ingenuity, which is unrivalled in making the best use of water in a hostile desert environment. In this the Iranian contribution to the world's technology is probably unique. c) Iranian traditional building techniques show an ingenious use of natural resources without the consumption of additional power. d) Employing local materials in construction and repair work has many advantages as the original materials are close to the site. Meanwhile, these buildings contribute significantly to the economy by providing key attractions for tourism industry; and elimination of such traditional techniques equals the erosion of centuries of construction culture [5].

Abyaneh Village

Abyaneh is located 40 kilometers northwest of Natanz, and 80 kilometers southeast of Kashan. It is one of the villages of the township of Natanz. It is at an elevation of 2300 meters above the sea level. Abyaneh is placed on a steep slope of the northern feet of a valley which is formed by the erosion of Burzrood River. The difference between the highest point and lowest point of the village is about 70 meters and it is extended from east to west [7]. Figure (1) shows over view of the village.

Village of Abyaneh is one of the Iranian historical villages that contains some ancient and historical works from Sassanid period. It owns several unique attributions like the unique temple of Herpak, a Chief mosque with a unique Mihrab from Seljukian period, and several contextual houses harmonious with climate and mountainous land.



Fig1. A general view of the village Abyaneh

Architectural Characteristics of Abyaneh Village

Abyaneh is a village of living architectural traditions and styles (all in red clay) with total responsiveness to environment, and probably the most interesting example of human-environment interaction or adaptation to nature, wherein one can transcend the boundaries of time and space and experience the ancient civilization, life and culture of rural settlements in Iran. The village has a compact fabric, with narrow and sloped alleys, and houses located on the slope as if placed on a stairway, which are accessible from stepped passages. Here, the roofs of some houses can be used to serve as the yard for other houses higher up on the slope.

Also, Houses of Abyaneh have been built 1500 years ago, and they are one of the oldest human residences which are constructed by adobe on the rocks. Such houses are quite suitable for the limited space of the city. They are in various directions, some of them which have been influenced by the pre-Islamic architecture are facing east, and some are facing south or Qibla. Since there has not been enough space for all the houses, some of them do not have any particular direction. However when you look at the village from a distance, you will see an incongruent and florid collection on the feet of a gray rock, which is located over a beautiful green valley [7].

Additionally, the Grand Mosque located in the middle of the village, is very impressive and exemplifies local construction techniques. The sanctuary of the mosque has a wooden prayer niche around which there are unique and eye-catching patterns and carved decorations dating back to the Seljuq Period (1038-1194). Moreover, the building has some features and characteristics similar to architectural elements seen at the palaces of Perspolis Complex. Another mosque, called Porzaleh which was built during the Illkhanid period, is situated in the older core of the village. Its sanctuary is vast and the decorations are very similar to those of the tomb of Bayazid of Bastam, the great Persian mystic. The Hajatgah mosque, built next to a rock outcrop, dates back to the early Safavid era, according to an inscription on top of its entrance. Inside there is a beautiful and decorated sanctuary hall with large wooden pillars and cornices.

Most of these traditional buildings in the famous historic village of Abyaneh, one of the oldest vernacular villages in Iran, are made from the typical red clay of the region leading to a unique visual integrity. The elevation of buildings show a number of passive environmental modulation strategies such as use of thick clay adobe walls, with deep setbacks on the ground floor to provide the necessary shadow to window areas, as well as on the first floor of each building, shaded by a wide overhanging roof Figure (2). All openings of buildings have simple screen walls that enable natural ventilation while protecting the interior from visual surveillance.

In this vernacular example of rural settlement, building elements and spatial arrangements operate in a great synergy and are likely complemented by a rural migratory pattern of habitation in response to temperature changes at different times of the day and different seasons of year.

Generally speaking, all of these buildings indicate a unique and uniform design approach with high degree of respect to nature and local environment. Major principles of sustainability which have been adopted in vernacular architecture of Abyaneh can be summarized under following categories:

- Adoption of local construction materials resulting in uniform color and texture and minimizing construction costs
- Orientation of buildings towards sun light and the desired wind of the area leading to lower energy consumption
- Arrangement of interior spaces due to local culture providing the most comfortable space for privacy and interaction of family members
- Geometrical uniformity of all openings and the visual integrity of decorative elements

- Distribution of vegetation in exterior spaces of public buildings creating more natural and environmental spaces



Fig2. The use of thick clay walls

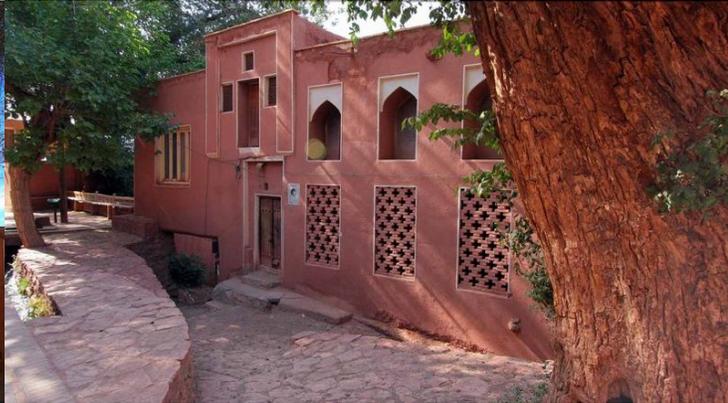


Fig3. Inner and netted windows of houses in Abyane.

DISCUSSION

Barton (2004) discriminates communities as natural settlement in which human and other species live together in coexistence. Urban physical systems (natural or manufactured) control the energy and water circle influences the quality of weather climate and soil. The Wheeler and Beatly (2004) offered models and provided examples on sustainable community in the second edition of his book entitled “The Sustainable Urban Development Reader” could be used as models for the explanation of the primary indexes of sustainable community design. Moreover the related scientific publications (books and papers) emphasized these models to be practical. Among the published books the following are the most important ones to mention “Sustainable Communities: The Potential for eco-neighborhoods” [8], “Designing Sustainable Communities, Learning from Village Homes” [9], “Planning and Design: Strategies for sustainability and profit: Pragmatic sustainable design on building and urban scales” [10], “Future Forms and Design for Sustainable cities” [11], “Toward sustainable communities: resources for citizens and their governments” [12], “Planning the good community: new urbanism in theory and practice” [13], “Sustainable Residential Development: Planning and Design for Green Neighborhoods” [14], “Living in the Environment: Principals, Connections and Solutions” [15], “Sustainable Urban Design An Environmental Approach ” [16], “Inside the Civano Project A Case Study of Large-Scale Sustainable Neighborhood Development” [17].

Generally speaking, sustainable architecture helps to create a healthy environment based on resource efficiency, conservation of nonrenewable resources, reducing consumption of renewable energies and quality promotion of life and human health [18]. The sustainable community is defined as a particular type of neighborhood with a well-designed and built environment, a range of employment opportunities, and a certain degree of social interaction and social cohesion that facilitates social order [19]. According to Sunder (2006) the sustainable community has developed choices which respect to relationship between the economy, ecology, and equity, often referred in the literature as three "Es"-. The “Economy”- serves the common good, is self-renewing, and builds local assets and self-reliant. The “Ecology”- Humans are part of the nature. Obviously, the nature imposes some limitations. Communities are responsible for protecting and building natural assets. And the last is the “Equity” which is the opportunity for participation in all activities with benefits and decision-making processes within a society [20]. In most of vernacular rural settlements of Iran and particularly in Abyaneh village we can see combination of ecological and sustainable principles, for example local architecture in Central Iran has used inner and beautiful netted windows on very thick walls. They are wooden, brick, and small [21]. Figure (3) shows northward internal and netted windows in Abyaneh village near Kashan City. Most of them have too height from ground surface [21]. All of these properties reduce energy wasting from building. It means, thick walls gradually reserving heat during every day and gradually discharging it during every night. It increases passive thermal insulation as similar as porch and roofed alley action [21]. This research indicated that most of key principles of sustainability have been employed in vernacular architecture of Abyaneh. These principles of vernacular design and construction are sorted and summarized in Table. 1.

Table1. Vernacular, Sustainable and Architectural Aspects of Abyaneh Village

Architectural Aspect of Abyaneh	Sustainable characteristic	The Obtained Result
Village Texture	Condensed and compressed	Reduction of the total exposure surface area. Reduction of heat exchange between outside and inside of the house.
Location of Village	Located on a slope of the northern feet of a valley and most of the buildings designed toward the south	To get more sunshine
Building Form	Extrovert building form	Abyaneh is placed in direction of river and surrounding hills So from climatic view point, Abyaneh is in good position therefor there is no need for central courtyard and the buildings are extrovert
SVR	The ratio of outside areas are less than inner areas and the buildings form are cubic so SVR is the least	It leads to reduction of heat exchange between outside and inside of the house
Village Alleys	Narrow and covered alleys called Sabaat	Over the days, this structure makes shade and prevent sunlight and also protect peoples from the cold wind in the winter
Light and Ventilation	Skylight	Openings are on one side of building, for vertical and bidirectional ventilation they use skylight
Materials	Local and self-sufficient materials such as: mud brick, stone and wood	They are close to the site and so does not need transport energy costs and environmentally friendly and more acceptable for goals of sustainability because with no pollution, these materials return to the earth
Roof	Flat	Hence wood is local material and available in the site they use wooden structure that is flat
The Buildings' Façade	Red sun-baked bricks	Insulate against rain and humidity
Walls	Very thick	Thick walls reserving heat during every day and discharging it during every night
Windows	Inner and netted and located in the upper parts of walls	This structure creates shade and increases passive thermal insulation

Conclusion

It is worth paying attention to traditional concepts of sustainable design that have been developed in ancient rural villages towards the new urbanism models of so-called modern era. These models can be manifested discussed throughout the two models of eco village and smart growth.

Techniques of vernacular architecture in rural settlements of Iran have been a true manifestation of co village idea and are particularly important because they are the result of centuries of development and practice. In Abyaneh, mosques, houses and all kind of buildings are in harmony with nature, climate and mountainous land. This village is one of the most interesting examples of human adaptation to nature, wherein one can see the conception of sustainability in ancient civilization and culture of Iran.

These creative architectural techniques were considered to make use of natural energy, ventilation and led to an ideal comfort for users of the building. For example the village texture is condensed and compressed and the total exposure surface area of each building is the least so, it leads to reduction of heat exchange between outside and inside of the house. Furthermore, to provide shade, some parts of alleys are covered. Moreover, using renewable fuels like solar energy and also using wind energy for ventilation and cooling of inner spaces by designing Inner and netted windows and also skylight windows and harmonic designing with site and climate aims at respecting environment. Above all, employing local materials in construction and repair work and correct orientation of buildings, were made these vernacular monuments as best example of sustainable design. So, these methods and techniques can be considered as an appropriate pattern for contemporary architecture of revitalization of rural settlements in Iran.

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