

Utilizing the Central Courtyard of Traditional Architecture in Modern Architecture

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Abstract: The purpose of this study is utilizing the central courtyard of traditional architecture in modern architecture. Since the nineteenth century, the traditional architecture has been more taken into account. From this time period, the sixties century is significantly important. The studies on the traditional architecture were conducted and followed in this period with the new objective and attitude. Until the early sixties century, most of the studies on the traditional architecture were briefly based on the a few enthusiasts' individual interests and goals, but after those years, the studies on the traditional architecture were considered with a new perspective and at a greater level by the architectural researchers because of the modern architecture development and appearance of its deficiencies and uncertainty about this type of architecture. Central courtyard with its valuable features not only does not impose damages to the environment, but also is compatible with it in such a surprising way. This special structure has expanded its own valuable properties in every structure and then in urban texture of desert areas such as Yazd. The reckless elimination of central courtyard rich model, the traditional architecture will lose enormous advantages. The lack of this valuable model and its reasonless elimination from the contemporary traditional architecture on the one hand and the lack of replacing the appropriate model for it on the other hand have made the numerous hidden and apparent damages to the body of contemporary architecture. This study explores the structure of central courtyard in traditional architecture as well as the advantages of this symbol of traditional architecture in line with the sustainable architecture and provides the investigation for its application of the need for contemporary modern architecture. The aim of such these studies is not to conserve and repeat the previous forms and imitate them, but to use their patterns and experiences and create new forms which follow the concepts.

Keywords: Central courtyard, modern architecture, traditional architecture

INTRODUCTION

After the rapid growth in the industrial societies and their modernization, the problems and deficiencies of these changes were revealed one after another and prompted the authorities to think. Its effects became apparent in all filed of society including the architecture. The reconsideration of pre-modern architecture and learning its positive aspects and reapplying its values and principles are among the solutions for improving and modifying the conditions of architecture. Thus the traditional architecture was considered as a source for finding the solutions for resolving some of the deficiencies and problems of modern architecture in different parts of world after the sixties. Therefore, not only the studies in this era were followed for understanding the traditional architecture, but also in order to find the solutions for continuity of its positive characteristics. Thus, the motivation and objective of conducting the studies on the traditional architecture and assessment of its characteristics was to find the ways to transfer or recreate its useful logical principles. This was not done by the blind imitation and copy of its appearance, but through the conscious and deep understanding of esoteric principles of architecture.

To achieve the architecture with the identity, the old idea of modernity should be left. The modernity believed that the past and whatever associated with the history and traditions should be retired. Therefore, since 1970 most of the architects around the world found that historic blunder based on which their bases of architecture were formed for half of a century, then they began to compensate it by taking the inverse steps (Manzoor, 1989). They sought to return to the traditional architecture and culture of their countries and find the solutions for improving the status of their countries and achieving its proper identity.

Like every architectures rooted in local culture, the Iranian architecture, which was created first in the Iranian Plateau and then in the regions influenced by the Iranian culture paid attention to the climate and left valuable structures until the end of Qajar era. Evaluation of remaining samples indicates that the colors in the decoration of structures were affected by the hot and dry climate (Roaf, 1998). Even the shape of sun as the most important climatic factor can be seen in the decorative motifs like Shamse and Sun Wheel (Parsi, 2010). As noted, the people's interior lives were based on the particular culture and tradition, coordination among family members, climatic status, economic infrastructure and religious factors. However,

the imported Western architectures were first introduced as the single-element houses in which the yard or private open space was exactly in the opposite direction around the residential units and then these open spaces were enclosed by tall walls which in fact introduced a completely different lifestyle. Then other yards were built behind the houses and the urban life was attracted to designed terrace and Iwans (Robinson and Littler, 1991).

As time passed and lifestyles changed, the individual needs changed, though most of the physical and emotional needs have remained constant and immutable in the last 100 years. For instance, the humans required a broad, freer and happier perspective as well as complied privacy and the nature. Despite the fact that the traditional architecture has the aesthetic and valuable elements, it is not practical now. Some of the valuable concepts such as the spatial resolution, simplicity, versatility, introversion, hierarchy, providing the privacy, etc., are hidden at the heart of this architecture and the architects and designers should try to apply these concepts in modern architecture (Mir Moghtadaee, 2009). According to what was mentioned, it seems that the 1960s should be considered as the milestone and the conditions before and after it should be investigated in order to follow the effect of traditional architectural elements like the central courtyard in modern architecture.

THEORETICAL PRINCIPLES AND LITERATURE REVIEW

After several decades, when the modern architecture was considered as the fashion, numerous problems emerged in the architecture (as reaching the fourth generation of modern architects). These problems are presented by different people in numerous books and articles and are described here in details.

The International Congress of Modern Architecture (CIAM) clearly referred to the relationship between the architecture and wider economic and political spheres of society in 1928. Furthermore, it paid attention to a relatively strong influence of realities in the industrial world on the architecture and noted that enhancing the handicrafts and traditional production should be less taken into account and on the contrary the global logical and rational methods of production be considered in order to enhance the general quality of architecture. Blake (1977) was among those who describes the emerged problems of modern architecture in details and responded to this question: "Why Modern Architecture Has not Worked?" in a book with the same name (Blake, 1977).

Is it possible to build a kind of architecture which pays less attention to the function and has a coordinated presentation as well as the clear and rich meaning while taking the function into account (Roth, 1994)?

Manzoor described in his treatise on the subject of tradition and development that there are some of the irrelevant and inappropriate values and ideas in designing the settlements and architecture projects in developing countries including Iran (Manzoor, 1989). Chadirji (1986) investigated the architectural ideas and patterns imported to Iraq and made the recommendations towards a traditional architectural style which had the global level. He described in his book the cultural and architectural crises of country and found that there was such a similar problem in other developing countries. Bandyopadhyay (1992) from Oman wrote that: Housing and plans of residential complexes manifest the profound influence of the West and this is now called as the modernity and progress in recent years, but is nothing but the blind imitation of Western models in practice. Such these residential structures and complexes have been totally unsuccessful and failed in compatibility with the cultural, ecological, climatic and environmental conditions (Bandyopadhyay, 1992). Despite the fact that the role of environmental and geographic phenomena in the formation of open spaces or courtyards is more or less obvious, some scholars have considered the cultural factors as the main causes of forming different kinds of yards in the traditional houses (Soltanzadeh, 2001).

The central courtyard structure is the essence of organizing the space in the Iranian plateau which has made the integrated appropriate responses for these people's material and spiritual lives. This study presents the applications of central courtyard in the traditional cities and houses according to the principles of Islamic and traditional architecture in Iran. Furthermore, this study seeks to investigate one of the basic elements of Iranian plateau cities (central courtyard) and evaluate in terms of stability (Ahmadi, 2005). Each new style of architecture is based on the principles, methods and traditions of previous styles, thus there was a strong relationship among different architectural styles in the past, so that distinguishing them from each other seems difficult. This proximity of architectural principles and methods among different styles is derived from the individuals' similar culture, traditions and behavioral patterns which make the architectural styles for responding to new needs as the result of slight changes in people's lifestyles and culture that is rooted in time (Dousti-Motlagh, 2009).

In a study entitled as "The role of courtyard in the sustainable architecture of past", Mashaei-Shokouhi and Ziapour (2009) reviewed the sustainable architecture and courtyard and its role in the sustainable architecture of Iran and finally came to the conclusion that it was necessary for the architecture of this land. According to Mashaei-Shokouhi and Ziapour (2009) experience in designing the complexes in Iran and utilizing two courtyards in two sides of house, they argue that the sustainability can be apparently

experienced in the modern architecture and segmentation system of cities in order to see the presence of courtyard in today sustainable and green architecture. Abel (1986) called the retrieved traditions of Islamic architecture as the renaissance of Islamic architecture. He argued that that renaissance had the capability to provide a contemporary traditional architecture with high, reliable and acceptable quality in the communities. According to his viewpoint, that mentioned capability depended on the higher enrichment of Islamic heritage in the societies. Such this heritage have passed the continuous and evolving process behind for over 1200 years and is able to compete with the West's classical architecture (Abel, 1986).

MATERIALS AND METHODS

The aim of conducting this study is primarily to pay attention to the impact of modern architecture on shaping the open space of houses and then providing the structural features according to the sustainable architecture of traditional architecture especially the central courtyards of houses. The historical interpretational method is applied in this study. The effects of modern architecture are the independent variables and the open space or central courtyard is the dependent variable of this study. Data collection method is done both by the documented and field ways. According to the theoretical framework of this study the modern architecture plays an important role in shaping the new houses. Furthermore, a new classification of various central courtyards is provided and it seems that it can clarify the open space applied in the traditional houses of Iran.

RESULTS AND DISCUSSION

The years after 1960 were the eras of doubtful modern architects throughout the world (Fig. 1). At that time, they must accept that the modern architecture was based on the theoretical imperfect and immature bases and some false theories. Thus as Kollar (1995) described, a doubt raised among the architects and professional architectural community about the accuracy and integrity of modern architecture, implementation method and the way of it functions in the society and the ideologies of modern architecture and the structures, which were not so committed to the principles and attitudes, slowly began to emerge in the society (Kollar, 1995). In other words, the architects sought to save themselves from the constraint and previous attitudes and make a new architectural movement. After 1960, three general trends emerged in the architecture. All three trends posited a degree of uncertainty and un-sustainability. The first trend denied the need for perfection. The second trend consisted of



Fig. 1: A view of modern architecture in Europe in 1960s

the flexible and changing architecture and denied the patterns of current life. The third group supporters believed in the retrievable architecture (Kollar, 1995) and questioned the necessity for survival and longevity of structure and it doubted about it.

Some researchers also tried to keep away from any particular tendency and accurately study the architecture of their surroundings in their country to study and find the solutions for the problems and weaknesses resulted from following the modern architecture. This group of individuals sought to search and follow the solution for the problem of modern architecture in their countries through the strategies at the heart of previous traditional architecture. Frampton (1992) considered this number of architecture around the world as the outstanding and significant works and "classified the architects under a title". He argued that: the certain individuals have proven again that they are able to do significant and considerable works (Frampton, 1992). He also discussed about the samples of these works in the countries such as India, Finland, France, Spain and Japan.

This latter group of architects pays more attention to the architectural identity of their countries and is inspired by the cultural and architectural heritage of their countries for solving the architectural problems. They are attracted to the traditional architecture of their countries and received the valuable and appropriate ideas which have been affected by the traditional architecture and been effective and useful for the architecture of their own era and their social conditions. In other words, these architects have sought to achieve "the historical and significant architecture" and implement it for their countries (Diba, 1992).

Like several other Islamic countries, Iran has been faced with the fundamental changes from the traditional to the contemporary system or modern Western system. These changes were started from the early twentieth century and continued until the Islamic Revolution of Iran in 1979. After the Islamic Revolution of 1979, the modernization and Westernism process, which was done in all cultural, social, economic, political, etc dimensions, was stopped and an inverse process began for the Iranian and Islamic architecture. This approach was found in all areas of society including the realm of architecture (Vaziritabar, 1990).

In the modern world, despite the fact that the modernity was along with the technological advances as well as the valuable scientific findings and the era of hope, it was only one side, the second was dark. With the emergence of industrial revolution and changing the human lifestyles, the technology operated in opposition to the nature and became a disaster for the environment. Among these, the structures played the big roles in enhancing the environmental crises, thus paying attention to the sustainable architecture in modern societies is not only an option, but an essential necessity. On the other hand, despite raised sustainability issues in modern world, all these principles were naturally applied by our predecessors. The early architects inevitably relied on the natural resources and clean energy which were endless. However, the inappropriate use of technological advances over time led to the forgotten techniques and unrestricted use of nonrenewable fossil fuels (Mehdizadeh-Seraj, 2008).

In the Iranian traditional cities and architecture, the open and closed spaces or the indoor and outdoor are so interconnected and each of them determine the other. Open spaces play the pivotal role in such this architecture and make the traditional architecture significant and with identity. Unfortunately, the contemporary architecture suffers from the illusion of open space and the today cities are along with the disarray, confusion and amnesia. The structures have lost their integrity and responsibilities towards the earth, sky and adjacency. The spaces are leaked from them to the outside like the water and the open spaces are considered to be abandoned" (Haeri, 2009). The contemporary architecture of Iran is faced with the challenges due to ignoring the importance of open space. The open spaces such as the courtyards, squares and alleys, where were as the key determinants of traditional Iranian architecture, have become as the residues and lost their importance and richness because of the unconscious imitation of European statuesque architecture. It seems necessary to mention here that the purpose of such this study is not to maintain and repeat the previous forms and imitate them, but it considers their patterns and experiences and makes the new forms according to the concepts.

Iranian traditional architecture in desert regions is formed without relying on the fossil fuels and through saving the energy and the open space of central courtyard has been as the determinant in saving the energy due to its specific dimensions, orientation and location targeted location. In these areas, the dense texture has provided the compatibility with the climate and the energy is saved as the result of reducing the surfaces exposed to the sunlight. Energy conservation is provided through the compact residential units so that even some residential units are often connected to other units from four sides.



Fig. 2: A view of courtyards in the traditional houses of Yazd

The central courtyard is the main space of desert houses. These houses are typically situated facing Qibla and the spaces are organized around the central courtyard. The courtyard is consistent with the movement of sun; the southern vault (Soffeh) is the place with shadow and the Northern is the royal seat and position of sun. Such this organization and orientation have made the summer and winter spaces logically around the central courtyard. The house builders have allocated each side seasonally and hourly according to the effect of solar rotation on several sides. With regard to this issue, the side facing the sunshine is the place for staying in winter and the side, behind the sunshine, is for staying in summer and the western side is considered for the hours in the cold winter days and in most of the cases the Eastern side is built with the arcades in order to avoid the severe radiation of sun (Tavassoli, 2002).

Water pool in the middle of the courtyard with maximum dimensions stores the solar energy and decreases the heat of summer (Fig. 2). This pool along with gardens, trees and boundless sky provide the limited but fresh nature. On the other hand, the central organization around the open space plays a significant role in reducing the effects of violent wind and storm of desert and the heat loss as the result of them. The temperature difference between day and night areas is high in these regions. The structure builders have utilized this feature and intelligently managed the natural and clean energies like the wind and solar ones through the facilities provided by the central courtyard. They have saved the heat of day in winter for utilizing at nights and the cold of night in summer for utilizing during the hot days. In the summer, "the deep and enclosed central courtyards save the cool air of night like the pit and give back to the environment in the hot day" (Tabbaz, 1996). The clay makes the delay time about 7-9 h. The high heat capacity and thermal properties of these materials "cause the heat to be absorbed at its peak and give it back gradually and with smaller amounts in a specific time period" (Tavassoli, 2002).

Using this feature in the winter, the thick mud and brick walls near the courtyard and the brick paving store the solar heat in the winter and return it gradually to the environment during the night. Thus, the solar energy is utilized in the winter night. The conscious and



Fig. 3: Utilization of special colors and materials in traditional houses of Iran

purposeful ratio of indoors to outdoors in the traditional architecture is among the factors affecting the energy conservation. Another point of sustainability in these houses is to utilize the energy at the depth of Earth. As the result of courtyards and pits with deep gardens, a storey of structures under the ground level and thus effectively has the lower temperature than the environment in the summers and warmer weather in the winters due to supporting by the surface of ground; therefore, the energy fluctuations are minimized and not wasted. In fact, the Earth's crust protects the structure against the climatic factors and changes like a giant thermal insulation and the storm and wind will not be able to penetrate into the ground (Ghobadian, 1998).

Another important point is the longevity of these structures and energy conservation resulted from it. The maintaining and repairing the structures, which are built with hardship, are so important for the local people while facing the climatic and environmental adverse conditions and the local knowledge and materials and the central courtyards make the maintenance and repair much easier. In fact, for the maintenance and repair of structure, the central open space is like a workshop at the heart of structure and reduces the difficulties, thus repairing the structure is done without disturbing the residents and neighbors' health and pollution and this prolongs the lifetime of structure. Unlike the contemporary architecture, these structures live longer than the people; they are considered as an investment in their lifetime and will affect the future generations. Obviously, their lower quality will impose the public spending on the future generations. These structures save the energy due to their long lives (Edward, 2010).

The desert traditional houses with central open spaces have the admirable manner in order to cope with the harsh desert climate (Fig. 3). In fact, the climatic conditions are determinants in the formation of spaces such as the central courtyards and the importance of these open spaces in such this architecture. Likewise, Ardalan and Bakhtiar (2001) considered the space organization in the traditional architecture of Iran as the result of factors such as the climate and stated that: "First of all, the climatic condition makes the courtyard-orientation necessary in the architecture for the healthy life in this region".

In such these courtyards, all elements of house provide a livable small climate. Like a smart element, they resist against the cold, heat, humidity and wind and bring together the light, water, wind and plants like a natural oasis in order to build the comfortable environment for the residents in the undesirable environmental conditions. The interior courtyards with trees, pool and surfaces with little-water-consuming plants is one of the leading causes of moisture in the arid desert areas. The rooms, which are only open to these courtyards, are protected against the wind and sandstorms (Kasmaei, 1984).

The traditional architectural materials are chosen according to the natural resources, environmental resources and the climatic and environmental characteristics. The above considerations, which are among important indicators of sustainable architecture, are obtained thanks to the central open spaces. The soil is the most abundant local element in these areas and the traditional architects have intelligently made it as the mud and clay and utilized as the original materials of construction. This local element with retrievable, available, long-life, replaceable and climate consistent contents not only do not make problem for the normal environmental cycle, but also make the construction with minimal environmental damage and without the constructional waste possible. As the result of central courtyards at the heart of structure, the major portion of materials is provided from the construction site without any cost of transportation and extra energy because the soil remained from the excavation of courtyards and the pit of garden have provided the major portion of materials. Ahmadi (2006) thus the central courtyards not only paved the way for achieving the sustainability, but also they have the sustainability properties in the formation and construction.

"Human needs cover three needs including the basic, social-financial and perceptive needs. The basic needs include the biological, safety and security needs; the social-financial needs include the sense of social belonging, diversity, creativity and attractiveness of environment; and the perceptive needs cover the knowledge, learning and beauty" (Faryadi, 2004). Furthermore, the aim of architecture is to fulfill the needs above. "Putting the aim at organizing the human life space, the architecture carries the notion of desired architectural space for the worthy human environment" (Nadimi, 2010). Zoe (2009) argues that the appropriate architecture absorbs, trains and subjects the human spiritually.

The traditional houses of desert meet a wide range of human needs because of the central open space which acts as the heart of house. Comparison of these houses with Maslow's pyramid indicates that only the low-level human needs such as the physiological needs are not considered in this architecture, but it also fulfills the higher-level needs such as the safety, belonging and



Fig. 4: Central courtyard; link between the human and nature. Mortaz House in Yazd

love, self-regard, aesthetics and self-actualization. Therefore, these houses are human centered and are created based on the human needs and his significant presence which are now among the important indexes of sustainable architecture. Thanks to the small and lush nature of courtyards, the nature communication, which is among the basic human rights, is provided. Organizing the spaces around an open space at the center of house makes the link between the construction space and the beautiful nature and the courtyards as the meaningful spaces, where give the identity to the surrounding space, make the infrastructure for human learning from the nature lessons and the laws of creation while utilizing the semantic and aesthetic information.

Not only these courtyards fulfill the residents' physical needs and comfort, but also make their soul relaxed and safe. "They are created and developed consistent with the local people's abilities and aspirations in line with the ideas and attachment of a family in a few generations" (Eftekharzadeh, 2005) and respond to the individuals' different demands. As the result of courtyards inside and outside of the structure in addition to the way of organizing the open and closed spaces, entering the house as the privacy is also along with the hierarchy and turning round in the entry direction and the filters such as the corridor and vestibule where provide a sense of security and respect. For entering these houses, we should walk three paths each which are considered as the physical experience as well as the spiritual implications in the process of entering the house. They are the vestibule, narrow corridor and internal enclosure or courtyard (Kateb, 2005) (Fig. 4).

CONCLUSION

In summarizing the data presented in the above-mentioned sources, the contrast between the modern and Western cultures, imported to the Islamic communities and their traditional and local cultures, are the important common points of those sources. Given the above-mentioned contents, despite the fact that there is no precise and specific date for the beginning of this new trend towards the traditional architecture, there

is no doubt about the extension of this tendency among the Eastern and Western architects. This tendency towards studying and retrieving the traditional architecture was followed by two motivations. The first motivation was obtained as the result of dissatisfaction with modern architecture and reaction to the anonymity of local architecture and the inhuman qualities of modernization and its mass housing. The second motivation was achieved as the result of investigating the features of traditional architecture and the certainty that tracking and retrieving those principles could be instrumental for solving the problems and be helpful in practice both in terms of application and visual meaning.

Based on the findings of this research, the open spaces at the heart of structures like the central courtyards, orangery and pit not only have the sustainability-oriented characteristics, but also lead to the sustainable architecture and integration of sustainability principles. The pattern of central courtyard with its valuable features not only impose no adverse impact to the environment, but also it is consistent with it is a surprising way. This particular structure has expanded its valuable properties in every structure and thus the urban texture of desert regions such as Yazd. Because of the reckless elimination of central courtyard as a rich pattern, the traditional architecture will lose significant priorities. The lack of this valuable pattern and its reckless elimination from the Iranian contemporary architecture on the one hand and the lack of proper alternative to it on the other hand have imposed the numerous obvious and hidden damages to the body of contemporary architecture. Since the sustainability-based approach in the present century considers the ways, which are consistent with the features of central courtyard, thus it seems essential to pay attention to the efficient models such as the central courtyard in solving the contemporary social and environmental crises because the mentioned values in the central courtyards and the their principles are sustainable and their continuity in the current texture can also be an effective way to pave the way for achieving the sustainability and avert the contemporary environmental crises.

REFERENCES

- Abel, C., 1986. Regional transformation. *Archit. Rev.*, 180(11): 40-41.
- Ahmadi, F., 2005. Central courtyard in Iranian architecture. *Quart. J. Soffeh*, 41(Fall and Winter): 90.
- Ahmadi, F., 2006. Central courtyard city-house: Sustainable city-house; spiritual city- house. *Safa*, 15(41): 90-113.
- Ardalan, N. and L. Bakhtiar, 2001. *The Sense of Unity: The Sufi Tradition in Persian Architecture*. Translated into Persian by Hamid Shahrokh, Khak Publication, Isfahan.

- Bandyopadhyay, S., 1992. Rethinking progress: The case of Oman, An Investigation into its Built Environment. In: AlSaiyad, N. (Ed.), *Housing, Squatter Communities and Tradition*, Traditional Dwellings and Settlement Working Paper Series, IASTE, Centre for Environmental Design Research, University of California, Berkeley, Vol. 51.
- Blake, P., 1977. *From Follows Fiasco: Why Modern Architecture Hasn't Worked?* Little Brown and Co., U.S.A., pp: 11.
- Chadirji, R., 1986. *Concepts and Influences: Towards a Regionalized International Architecture*. KPI Ltd., London.
- Diba, D., 1992. Evaluation of Iranian architecture in the process of culture and history. *Sci. J. Archit. Urban.*, No. 16.
- Dousti-Motlagh, P., 2009. Investigating the history of entrance. *Armanshahr*, No. 2.
- Edward, B., 2010. *Guidelines on the Sustainable Architecture*. Translated by Shahrouz Tehrani, Mehrazan Publications, Tehran.
- Eftekharzadeh, S., 2005. Retrieving the space: Changing the residential unit to the house. *Quart. J. Archit. Struct.*, No. 6.
- Faryadi, S., 2004. Proposed urban design principles of sustainable Iranian cities in the globalization process (with an emphasis on the biological needs). *J. Environ. Stud.*, 33(Spring).
- Frampton, K., 1992. *Modern Architecture: A Critical History*. Thames and Hudson Ltd., London, pp: 329.
- Ghobadian, V., 1998. *Climatic Investigation of Traditional Iranian Structures*. Institute of Publishing and Printing, University of Tehran, Tehran.
- Haeri, M., 2009. *The Role of Space in the Iranian Architecture*. Cultural Research Bureau Publication, Tehran.
- Kasmaei, M., 1984. *Climate and Architecture*. Iran Housing Co., Tehran.
- Kateb, F., 2005. *Architecture of Iranian Houses*. Ministry of Culture and Islamic Guidance. Publishing Organization, Tehran.
- Kollar, L.P., 1995. *On Postmodern Architecture*. Research Paper No. 3, School of Architecture, The University of New South Wales, Australia, pp: 5.
- Manzoor, S., 1989. *Tradition and development*. Ph.D. Thesis, School of Architecture, Chalmers University of Technology, Sweden, pp: 17-20.
- Mashaei-Shokouhi, P. and M. Ziapour, 2009. The role of courtyard in the sustainable architecture of past. *Proceeding of the 1st Conference on the Sustainable Architecture*.
- Mehdizadeh-Seraj, F., 2008. Iranian traditional architecture and urban planning, the culmination of an effective and efficient utilization of clean and renewable energies. *Energ. News*, 5: 65-69.
- Mir Moghtadaee, M., 2009. Process of housing transformation in Iran. *J. Constr. Dev. Countr.*, 14(1).
- Nadimi, H., 2010. Again at the beginning. *Soffeh*, 50(Spring and Summer): 5-8.
- Parsi, F., 2010. Climatic spaces in the Iranian architecture. *(Me'mar) Architects J.*, No. 48.
- Roaf, S., 1998. *The wind catcher of Yazd*. Ph.D. Thesis, Department of Architecture, Oxford Polytechnics.
- Robinson, P. and J. Littler, 1991. *Courtyard passive solar houses: Demonstration project*. Final Summary Report, Project No: SE 432/85, EUR 13223 EN, European Communities, RIB, Polytechnic of Central London.
- Roth, L.M., 1994. *Understanding Architecture: Its Elements, History and Meaning*. The Herbert Press Ltd., London, pp: 501.
- Soltanzadeh, H., 2001. The role of geography in forming different types of courtyards in the traditional houses of Iran. *Res. Hum. Geogr.*, 43(75): 69-85.
- Tahbaz, M., 1996. The principles of a desert architecture, *Tehran. Soffeh J.*, 19/20(Fall and Winter): 79.
- Tavassoli, M., 2002. *Urban Construction and Architecture in the Warm and Dry Climate*. Peyvand-e No, Payam, Tehran.
- Vaziritabar, S., 1990. *Design and privacy in modern and traditional housing in Iran*. Ph.D. Thesis, Oxford Polytechnic, England.
- Zoe, B., 2009. *How to Look at Architecture*. Translated by Farideh Garman, Shahidi Publications, Tehran.