FEASIBILITY STUDY AND ECONOMIC-SOCIAL EVALUATION OF IMPLEMENTING THE SOLUTIONS OF GREEN DESIGNING IN TEHRAN CITY

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Abstract. The purpose of this research is to study the possibility of specified development and plan for converting Tehran to a sustainable and green city as a proper model for all cities in Iran. It was specified that green designing of Tehran not only causes to promote the social life quality, create interaction spaces and meet the mental and physical needs of citizens, but also economically causes to save the costs remarkably which are spent for achieving clean air, acoustic tranquility, quality and life span of buildings and use of cheap and clean energies. For this purpose, at first the importance of the green designing issue , study of green architecture background and its roots have been explained and then the general principles have been explained and in the continuation, the solutions of green designing in Tehran city have been mentioned.

Key words: Green architecture, sustainable designing, sustainable development, urban green designing

Introduction

According to the statistics related to the population fund of United Nations organization, the world population has become three times during the recent 70 years. Now, 75 million persons are being added to the world population yearly and the predictions have estimated the world population between 9.7 to 9.10 billion persons in 2050 (Dehghani Bidgoli, 2008). This statistic indicates insufficiency of existing sources in future. In an era that the energy crisis with its acceleration ends the sources existing in the world especially fossil sources quickly. For continuance of life, renewable and healthy sources like water are needed seriously (Sedaghati and Tayyeb Ghasemi, 2014). Access of developing countries to the kinds of new energy sources has significant importance for their economic development and new researches have indicated that there is a direct relation between the development level of a country and the amount of its energy consumption. With utilization of green architecture, negative effects of buildings such as pollution and destruction of environment have been reduced and at the same time, the quality of spaces is increased. Also reuses of consumptive water and substitution of clean and renewable energies instead of unrenewable and destructive energies promote the social and economic situation of environment in the earth tangibly.

In Iran country also with regard to the increase of population and following it, incremental need to the energy sources, limitation and reduction of fossil energy sources on one hand and the necessity of keeping the environment healthy and protection of it on the other hand, the necessity and importance of using of new energies (like wind, sun, water and thermal energies) become double (consumption management group of electricity distribution company of Semnan province, 2012). Green architecture is an old process, because it has existed fundamentally in many traditional civilizations and architecture such as Iran's traditional architecture. New issue is to understand and applying this important that in addition to create beauty and diversity in buildings architecture, embraces the protection of the natural sources, immunity from pollutants, protection of the Ozone layer and health of future of humanity. The necessity to apply this architecture as a duty for construction of buildings becomes more clarified in our country day to day (Dashti Shafiee, 2013).

1. The research background

Combination of architecture with nature and plants isn't a new idea; the idea of creating small garden on roof and cultivation on it has been applied by Iranian people on the roof of Ziggurats in 2500 years ago. Also green roofs had been constructed by Babylon's people 600 years before nativity (Razavian, 2010). Suspended gardens of Babylon in fact weren't the gardens suspended in the air, rather they were green spaces which were placed on the roofs and terraces of several buildings, but development of this phenomenon scientifically for the first time was expanded by construction of green roofs in Canada and United States in 19th century. Modernist architects like Le Corbusier, Frank Lloyds Wright and Roberto Beverly Marx whom are accounted as the main owners of green architecture idea, promoted the advantages of roof-gardens and constructed modern green roofs (English nature, 2003: 498). From successful samples of modern roof-gardens since 1930s onward, famous garden of Rockefeller in New York, modern roof-garden of Kensington in London can be mentioned (Dabaghian, 2009). Between the years of 1950-1990 in most of the countries, multi-floor buildings which were constructed with «international style» were similar with administrative buildings. Ventilation devices were substituted instead of natural ventilation. Construction of terrace was ignored and nature lodged for automobiles and car parks. Discussion and researches about green designing are very few in our country and with regard to the importance and necessity of issue, they need and depend on the doubled study, deep thinking and ambition. We hope that after writing this article, the attention of more researchers to be attracted to the therapeutic and hospital issues and it leads to study and collect a research with new approach about sustainable and green designing and new models and findings.

Zandieh and Parvardinezhad in a study entitled "sustainable development and its concepts in residential architecture of Iran" know that the most important factors which pollutes the environment in the world and especially Iran are fossil energies which are used for providing and supplying the consumptive hot water and heat of residential spaces, in the continuation, they know traditional architecture as a kind of sustainable and green architecture and according to this, they suppose that utilization of Iran's traditional architecture in residential and non-residential sections and even combination in general and vaster level like city is necessary. Keshtkar Ghalati et al., (2010) in the article of "development of green roof system according to the criteria of sustainable development in Iran" introduce the green roof system and study its kinds and features and know the green system as one of the sustainable development components. Razavian and et al., (2010) in their research introduce green roofs or roof-gardens as a proper solution for reconciliation with nature and change of urban perspective and they study and analyze its defects and advantages in comparison with normal roofs. Dashti Shafiee also in an article entitled "studying the principles and place of green architecture in Iran and presentation of solutions for development of it" meantime emphasis on existence of green architecture in an old process and belonged to the ancient civilizations, understands the important and discussable issue and introduces its practical application in Iran and adds "the necessity of applying green architecture as a duty for construction of buildings becomes more clarified in our country day to day" (Dashti Shafiee, 2013).

2. Methodology

Information collection method: Since the methodology always follows the research subject, with regard to the current research subject, two main methods have been used in order to collect the information: 1-Documentary method, 2-surveying method.

Methodology: In this research, the applied methodology is a descriptive-analytical kind and the information collection method is a library, grounded and surveying kind. In this method, the researcher has used of his most important tool namely note-taking.

2.1 The research questions

In order to do the research, at first some questions related to the studied issue were proposed so that the research to be expanded according to these questions and the intended purposes to be achieved. These questions are as follows:

-Whether green architecture has been come out in executive form in our country or it has remained in the theory tradition.

- In what regions has green architecture been used applicably?

-What are the benefits and profits of green architecture for Tehran Township?

-Is the execution of projects justifiable in green form for Tehran's constructors?

3. Sustainable development

3.1 Sustainable development definition

According to a definition which has been expressed by World commission, Environment and development, sustainable development[1] meet the needs of today's generations without threatening the abilities of future generation in meeting its needs (United Nations, 1987).

3.2 Purposes and principles of sustainable development

The sustainable development concept is an important change in understanding the relation of human, nature and humans with each other. This issue contradicts with the look of two centuries ago; a view which is according to the separation of environmental, social and economic issues. It can be said that sustainable development and sustainable architecture with regard to their initial rites consider the protection of environment with changing the approach to the nature. Reforming the look to the nature and consequently changing the human's behavior to it which will lead to change the consumption culture is a very significant step in sustainable development. Originally, neither natural nor social conditions can have superiority situations to each other. A co-construction process should be recognized and searched. In this path, instead of accounting the nature as an independent and external existent which should be saved or utilized, we should understand and communicate with nature through different ways.

[1]- The three Rs: Reduce, Reuse and Recycle

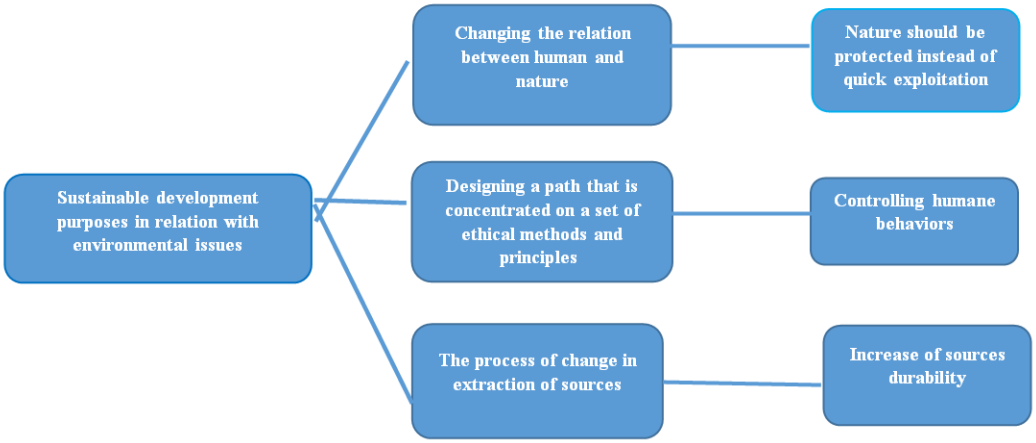

Figure 1: Sustainable development purposes

Generally, sustainable development has three main indexes:

A) Sustainable ground of sources which is resulted from populations and ecosystems utilization.

B) Biological diversity of individual species in the ecosystems ground in comparison with human utilization and more generally human's interventions.

C) Sustainable economic development without destruction of existing sources for future generations.

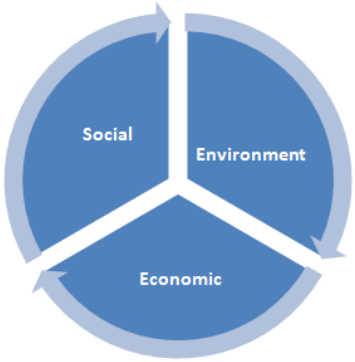

Figure 2: Sustainability domains

3.3 Principles and stages of green architecture

Nowadays, sustainability issue is proposed in different scientific and executive domains all around the world. In architecture, sustainability is also proposed. Imposing the least destruction on environment, regard to the biological diversity, reduction of pollution and wastes in natural environment, reduction of greenhouse gases in the earth atmosphere, use of clean and renewable energies, use of local and recyclable materials, regard to the physical and mental health of society's people economically, socially and culturally, protection and resuscitation of historical textures are some cases which are considered by sustainable architecture (Ghobadian, 2013).

In sustainable development, it is attempted that environmental issues to be observed in 3 stages of construction, residence and destruction of building (diagram 3). In the construction stage, local and natural materials should be used,; for example, stone in the mountain, brick in desert and wood in forest are from proper materials for construction sustainably, because the factory process of these materials is very small for being converted to the building materials and many costs and energies aren't consumed for transportation of them to the building workshop.

In the residence stage, it is attempted that the need to the energy to reach to the minimum and clean and renewable energies like sun, wind, or biogas energies to be used instead of fossil energy. Therefore, in sustainable architecture, using of fossil energy is prevented as much as possible. One of the problems in current century is the limitation of fresh water and incremental need of human to it. Therefore, this vital material should be used correctly, with awareness and least prodigality. Due to this, at first by using of new equipment, the consumption of it should be reduced. Using of rain and well water, saving and refining it in the place are emphasized by sustainable architecture. Also reuse of rubbish or in other words, rubbish separation in the origin and hygienic disposal of it in a form that creates the least local waste are from other cases which are considered in sustainable architecture. Nowadays in western countries and somehow in our country, cases like paper, cardboard, glass, plastic and metals are separated from rubbish in the origin and each one above cases is sent to the related factory for being converted to the materials for new products.

In the stage of building destruction, it is attempted that building materials such as brick, stone or girder to be reused and wastes or what isn’t reusable are disposed correctly (Ghobadian, 2014).

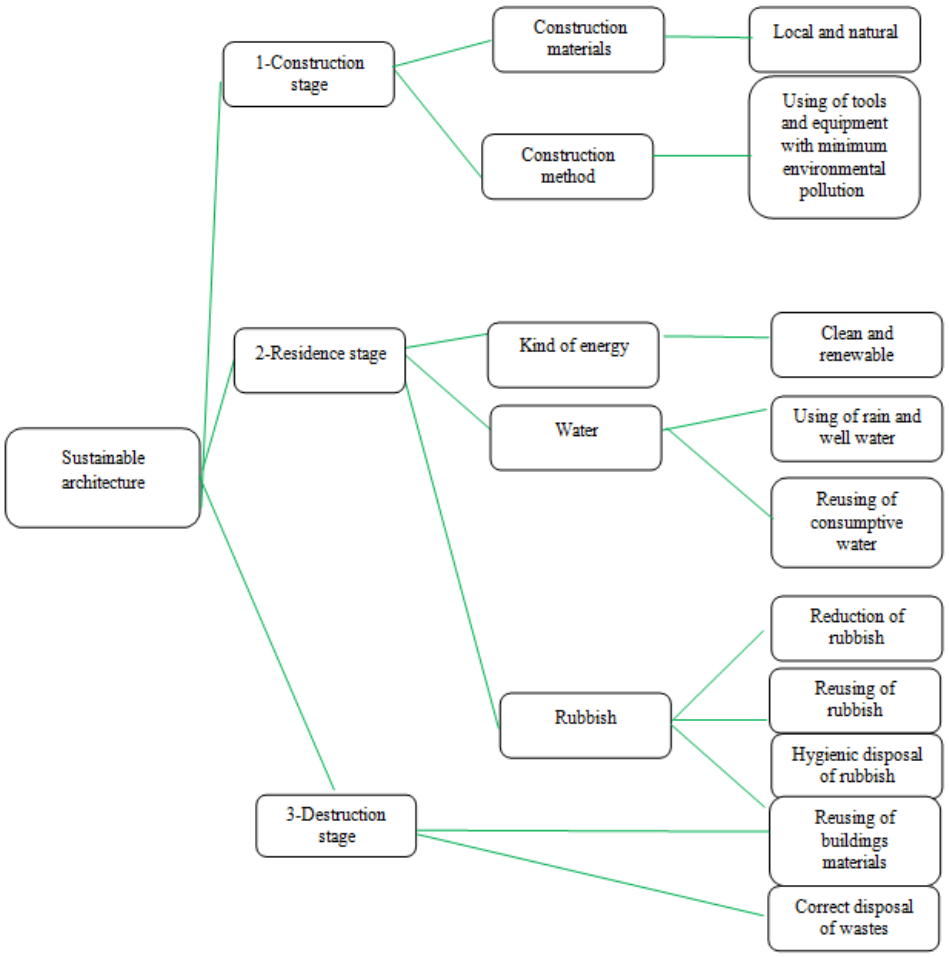

Figure 3: Triple stages of sustainable architecture for protection of environment (Ghobadian, 2009)

Green designing stages include compiled planning. Planning includes recognition and evaluation of needs, formation of specialized work-groups, designing according to the region conditions (climate, topography and kind of soil), selection of designing site, selection of green materials, selection of green mechanic and installation system, utilization of site and natural landscapes, constant protection and repairmen (Dashti Shafiee, 2013). A study which was done by the environment section of Canada in Toronto in 2002, indicated that urban temperature will be reduced from 1 to 3° if only 6 percent of the city's roofs are green (government of Canada, 2002).

3.4 Green architecture in Iran

In Iran also green architecture hasn't been unknown and historical city of Masouleh can be accounted as one of the most successful samples of local architecture experiences in green building which has ecological and environmental architecture designing and urban texture (Dashti Shafiee, 2013).

In Iran according to the last announced statistic, 41 percent of the whole energy consumption in the country is in the domestic and commercial section. An architect should design a system which is compatible with the processes of biological system and natural energies consumption with the least destruction in the biological system and also he/she should use of renewable sources cautiously. Therefore, green architecture has proposed itself as an architecture compatible with climate and most of architects in recent decades have had abundance tendency to design the buildings in the green architecture domain (Dashti Shafiee, 2013). In relation with metropolises like Tehran that on one hand is facing with environmental pollutions like air pollution, pollution arising from urban sewage, acoustic pollution, pollution of superficial waters and on the other hand due to the existence of thermal islands and increase of temperature in urban centers arising from non-standard and non-homogenous development of urban textures and with excessive consumption of fossil energies, it seems that now the best time for expansion of green architecture is accounted as the effective solution in optimization of contemporary urbanism of Iran (Ghiabaklou, 2010).

4. Executive solutions of green architecture in Tehran

- Project designing and multi-purpose maps in which the residential and commercial uses have been combined with each other in order to help to create alive communities and also reduce the fossil pollution sources of machines.
- Maximum use and expansion of public transportation, biking paths and pedestrians to the significant and necessary services of city.
- Using of walls, facades and green roof has the main role in management of waters arising from raining, recycle of water, reduction of greenhouse gases effects, environmental diversity in urban creatures (plants and animals), prevention from UV radiation to the building, reduction of temperature, moderation of air, improvement of climatic quality and creation of air conditioning in the city, creation of urban beautiful landscapes, palatability and utility of urban spaces, cleanness and reduction of air pollution, saving the energy, reduction of acoustic pollution, reduction of costs related to the protection and replacement of building's roof, creation of tranquil environment in the urban chaotic areas and increase of new spaces for recreational activities[2].

- The buildings should be replaced in a manner that the existing environmental and climatic situation to be utilized maximally and the building should be designed compatible with it, like using of vegetation flexible with autumn in the southern side and eastern and western expansion of buildings for optimum planning and using of solar energy.
- Using of natural and renewable energy for houses and commercial places which have high share in energy consumption.
- Using of clean energies instead of fossil energies which have high pollution.

[2]- www.civilica.com

- Using of solar panels and heater and saving it in the designed sources and using of it in the cloudy and cold days of winter and autumn.

Nowadays, the buildings also form a part of environment and create a great part of environmental pollutions. Of course, construction cannot be stopped but with a precise thinking, designing and planning, those kinds of buildings can be constructed which have the least negative effect on the environment (Zandieh, 2010).

The effective factors on increase and reduction of constructing green buildings

Advantages

Encourager policies of government, subsidy and facilitating in using of new and clean energies and green materials

Informing and educating the architects, designers and utilizers of advantages and life quality compatible with environment and green architecture

Increase of fossil energies cost

Defects

Slow procedure of promoting clear standards of construction and grading the buildings in the energy consumption section.

Slow procedure of controlling the qualitative level of execution by contractors

Unawareness of profits and positive effects of these constructions on the environment, future and life quality of humans.

Encouragement and unsparing supports of mayors in this regard have led that the owners of constructions to find out the advantages of applying this technology in designing, planting, allocating and constructing the roof-gardens and value added arising from them. According to the existing estimates, nowadays about 10 percent of all roofs in Germany somehow are green roof[1].

5.1 The models of converting Tehran to the green city

Difference between a new green roof and a traditional green roof is related to the difference of purposes and materials applied in this kind of roof; the main purpose in the past has been the use of grass for insulation and elimination of caulk layer that has been often accomplished by trees' bark.

But nowadays, green roof is constructed with the purpose of environmental and economic health and in relation with improvement of management, reform of superficial sewage in the city and regard to the aesthetic issues (Ghiabaklou, 2010). With increase of modern world's problem, sustainable systems were placed in the priority of developed countries' policies. Developing countries like Iran now are also seeking for execution of these policies in order to solve different cultural, social and environmental problems and with considering the economic consequences.

The costs of designing and executing a green roof shouldn't be compared with the costs of a normal roof; rather this comparison should be accomplished with stupendous costs arising from water, air and environment pollution, diseases and death arising from these pollutions, individual and social damages arising from lack of green space in artificial environment. Heavy costs of using of fossil fuels downwards, deep psychological effects arising from ugliness and inanition of cities, problems arising from flood-waters, costs of controlling the superficial waters, costs arising from insulation, re-execution of traditional black roofs should be added to the above costs (Keshtkar Ghalati, 2010).

Incremental and imbalanced development of Tehran city has caused to increase the procedure of land demand for construction of different uses especially house. In urban uses planning, the amount of per capita is an important tool which can play role in providing urban designs and manner of distributing and dividing the lands in the city. With regard to the development of strategic designs and abolishment of comprehensive traditional designs, the attitude of using of urban per capita has been changed to high extent. One of the achievements of this new approach includes: emphasizing on the quality issue vs quantity and valuing the people' participation. According to the existing information, the constructed lands (roofed) with different uses have formed 67.9 percent of Tehran's space with an area of 730 km^2 and the rest is related to the passages and open spaces. With regard to the population of Tehran city, the land per capita averagely is 81.9m^2. The most per capita of uses is related to the residential per capita with 22 m^2 which has allocated 26.9 percent of the constructed lands to itself[1]. According to the statistics of Tehran municipality, total area of parks in this city is 1298.6 Hectare currently. Among urban regions of Tehran, the most ratio of green space level to the total area of region is 77.45 percent in region 22[2]. The standards of green space determined for each person is 12m^2 that with regard to Tehran's population with 13 million persons, the per capita of existing green space is less than standard. In such conditions, with encouraging the citizens to execute green roof design, at least about one-fifth of Tehran city level can be converted to the green space and the amount of air pollution can be reduced tangibly (Razavian, 2010).

It is suggested for achieving green city of Tehran, in some cases, installation of green roofs to become in a law form like the lands that formerly have had green use, the areas with pollution crisis, factories, workshops and all buildings which pollute environment, all buildings and installations dependent on the organization in charge of green space, environment and related organizations, granting special supports like selecting superior designs of green roof or encouraging the assemblies which are environment lovers, creating ground for designing and executing the floored parks in the areas with high congestion which are facing with shortage of standard green space. Applying these policies in the society causes to propagate the use of these roofs (Keshtkar Ghalati, 2010).

6. Conclusion

Green architecture is an old process because it has existed in many traditional civilizations and architectures such as traditional architecture of Iran fundamentally. Between the years of 1950-1990 in most of the countries, multi-floor buildings constructed with «international style» were similar with administrative buildings. Ventilation device was substituted instead of natural ventilation. Construction of terrace was ignored and nature lodged for automobiles and parking. The environment ministration of America defines green building in this manner: "a process for increasing the building quality in which for the buildings and placement of them, water, energy and materials have been used and the negative effects of building on the human and environment health are reduced through better

location, construction designing, execution and protection of full life cycle of a building". Therefore, green building participates in ecosystem positively.

In Iran, according to the last announced statistics, 41 percent of total energy consumption of the country is in the domestic and commercial section. In green architecture, designer has constrained the natural energies and use of them in the buildings in best form. In a green building, those kinds of materials are used that don't damage the nature and rather they are recyclable, a building which has been constructed by using of materials in its environs and in establishment of such a building, easy access to the proper public transportation is considered. It is attempted that the building to be constructed with regard to the optimum direction of sun radiation and with the purpose of using of natural light and acquiring clean energy; and the importance of compatibility and balance of environment constructed by human in this kind of buildings is in priority but in "the profession related to the construction and sale of buildings", providing a way and possibility for entering the nature to the building isn't very important that although these solutions at first look contradict with governing thoughts, but finally they are as the most economical methods of architecture.

Study of 2002 in Toronto, Canada which was done by the environment section of Canada indicated that the urban temperature is reduced from 1 to 3°. If only 6 percent of the city's roof is green, although designing the green buildings will be good but it will not be promoter of affairs and it should be done simultaneous with a green urban designing. With regard to this issue that the construction of green space in the cities due to the shortage of land and its high price is very expensive and most of the lands have been occupied by buildings and streets, with converting the building roof to the garden, the nature conquered by the city can be returned to it and the per capita of open and green space can be promoted in the cities. Simultaneously, construction of roof-garden is an effective and cheap solution for reduction of environmental pollutions. The standard of green space determined for each person is $12m^2$ and with regard to the population of Tehran metropolis with 73 million persons, the per capita of existing green space is less than standard. In such conditions, with encouraging the citizens to execute the green roof design, at least one-fifth of Tehran city level can be converted to the green space and the amount of air pollution can be also reduced tangibly. Basically, the per capita of open and green spaces can be protected and promoted by expanding vertical green spaces in the buildings and their facades and also ordaining green construction laws in the domain of townships around large cities like Tehran. The costs of designing and executing a green roof shouldn't be compared with the costs of a normal roof; rather this comparison should be accomplished with stupendous costs arising from water, air and environment pollution, diseases and death arising from these pollutions and individual and social damages arising from lack of green space in the artificial environment (Gazzeh, 2010).

References

1. Dabaghian, F.: *alive roofs*, architecture journal of Manzar, No.49: Tehran, 2009.
2. Dashti Shafiee, A.: *Studying the principles and place of green architecture in Iran and presenting the solutions for development of it, second national conference of climate,* construction and optimization of energy consumption, Isfahan, organization of Iran's energy utilization, 2013.
3. Dehghani Bidgoli, R., Rajabpur Ashkiki, B., Keshavarz, A.: *water, sustainable development, sources and limitations, the first national conference of management and development of sustainable agriculture in Iran*, Ahvaz, higher scientific-investigative institute of Simaye Danesh, 2008.
4. Del Barrio, P.: *Analysis of the Green Roofs Cooling Potential in Green Roofs, Energy and Buildings*, Chicago, 1998.
5. Elliott, C.: *Technical Sales Representative*: Suprema Canada, Toronto, 2006.
6. Ghobadian, V.: *diaconate style and theoretical principles in contemporary architecture of Iran*, second edition, institute of architect's science: Tehran, 2013.
7. Ghobadian, V.: *principles and concept in the western contemporary architecture*, 27th edition, cultural researches office: Tehran, 2014.
8. Ghiabaklou, Z.: *green wall as an option for reduction of energy consumption in the building and organization*, optimization of fuel consumption, 2010.
9. Hancock, K.: *Energy Management Co-ordinator, Physical Plant Services*", Queen's University, Toronto, 2006.
10. Johnston, J.: *Building Green: A guide to using plants on roofs, walls and pavements*. Mayor of London; London, 2004.
11. Keshtkar Ghalati, A., Ansari, M., Nazi Dizaji, S.: *development of green roof system according to the sustainable development criteria in Iran, journal of city identity*, fourth year. 2010. Vol. 6, p. 78-85.
12. Olfat, M., Zarghami, E., Rahbar Sabaghi, S.: *studying the principles of designing the elders' residence with approach of environmental sustainability and green architecture, international conference of sustainable city*, Tehran, institute of cultural ambassadors of Mobin, 2014.
13. Razavian, M., Ghafouripur, A., Razavian, M.: *Green roofs, geographical journal of environment preparation*, No.10, 2010.
14. Salehi Amiri, R., Ghadami, M., Beikzadeh, Y.: d*esigning and presenting the model for evaluation of social capital effect on sustainable development dimension*s, journal of beyond the management, 2012. Vol. 6 (23), p. 15-37.
15. Sedaghati, A., Tayyeb Ghasemi, S.: *water and architecture in sustainable development, national conference of architecture, new urban construction and development*, Tabriz, national center of guilds communities of Iran's architects, 2014.
16. Xue Y., Ma, B.: The *Research of Green Design for Apartments for the Elderly*, Applied Mechanics and Materials 2013. Vol. 368-370, p. 566-571.
17. Zandieh, M., Parvardinezhad, S.: *sustainable development and its concepts in Iran's residential architecture*, journal of house and environment in rustic, 2010. vol. 29, p. 2-21.