# THE ROLE OF GREEN ROOFS IN URBAN SUSTAINABILITY

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**Abstract**

Dynamic urban processes and constant evolutions in the types of living as well as technological advances have changed and manipulated living environments for human beings. The increasing growth in the population of urban regions and the escalation of socio-economic problems have forced human beings to live in matchbox apartments during the last a few decades. Modern human beings have to encounter different daily activities to make living; hence, having a shelter which can bring peace and relief has become a dream for him. Recent urban views and sights have been changed into apartments and tall towers in the residential areas which have made human habitats gloomy and bleak and have created several problems for modern citizens. It can be argued that, regardless of the internal peace of houses, urban citizens need beautiful and green natural views and sceneries far from the tensions of work environments so as to comfort their minds and imaginations. Projects for modernizing, optimizing and creating new urban spaces are realized in different areas for many years. The present study is intended to examine the concept and idea of *green garden* which has been proposed by developed countries. The concept of *green garden* was proposes as an attempt to fulfill tranquility, peace and a desirable habitat. The present study investigated and evaluated this proposition based on the following criteria: compatibility, desirability, efficiency, comfort, safety and health.

**Keywords:** City, house, urban views and sceneries, green roof

## Introduction

The urbanization process and the number of existing cities have had an increasing growth in recent years. That is, while there were 201 cities in Iran in 1956, the number of cities in Iran in 2011 grew to 1331 cities (Iranian statistic Center, 2011). This indicates that the number of cities has significantly increased and many villages have been merged with cities. According to the census report in 2011, 71.4% of the population lives reside in cities; however, the related figure for the year 1956 was 29% (Iranian statistic Center, 2011). In other words, during the last five decades, the urban population in Iran has become more than doubled. Many researchers speculate that the urban population of the world will reach 70% in 2050 (Pecarevic, Danoff-Burg, & Dunn, 2010). Such an increase in the number of urban population will call for certain arrangements so that the needs of urban citizens can be met. A critical issue which has been caused by the growth of cities and citizens is that urban living environments should reach sustainable development in cities. Fast developments in civil technologies and IT have evolved cities significantly. These evolutions have inevitably

changed the urban lifestyles. The plethora of apartments and the small spaces and areas of apartments do not allow citizens to make efficient use of outdoor spaces; hence, children and old people whose number is increasing are deprived of green urban spaces. Green roof can be considered as a solution for doing away with ugly brick and concrete views of city buildings.

Green roof is a roof with a herbaceous covering; this technique can be applied in line with the purpose of preserving the natural environment in urban areas (Kosareo & Ries, 2007, p. 2606). The results of applying this method in cities indicate that green roofs as a novel and modern method can help reduce the undesirable heat in cities, improve the quality of natural environments and the weather in cities.

- Statement of the Research Problem

It has been argued that the population level of the developed countries will rise to 83 percent until the year 2030 (Mentens et al., 2006). According to the published statistics by the World Bank (UN, 2012), in the year 2012, 53% of the whole population resided in cities and this amount increases constantly at every moment. Urban citizens are merging a lot of rural lands and villages into cities so that they can construct houses and settle in cities; in doing so, they damage and destroy many gardens and farmlands. Thus, numerous proper gardens and farmlands are destroyed to construct houses, streets and transportation channels. Non-sustainable and inefficient use of the urban systems has caused several problems. One significant problem which is attributed to increased urban population is the excessive and unreasonable growth of the constructions and buildings in urban environments which destroy beautiful urban sceneries and views. Consequently, citizens have to begin their mornings and days by looking at tall buildings and small matchbox houses and sky scrapers for commercial centers. In general, these areas inspire colors, symbols and feelings which are meaningless. One can no longer observe beautiful natural views and prospects in modern cities. In the majority of urban areas, only construction standards are met to create dismal parks which are devoid of enough and desirable grass coverings and trees; these environmental problems can cause psychological and spiritual problems for urban citizens.

The excessive utilization of the surface of the earth for different purposes leads to their destruction. Many researchers argue that having green surfaces in cities is essential for avoiding disturbing and perilous heat. Green covering of the surfaces around building can help reduce the limitations of the urban spaces (Kumar, 2005, p. 1505). Therefore, green roofs can be regarded as an achievable plan and scenario for metropolitan areas. Flat roofs lack aesthetic architectural considerations; hence, they have no role in the aesthetic and architectural value of a building. Flat building surfaces give a tough and rough impression and appearance to the outlook of urban building and cities and also they need a system for disposing rainwater (Razavian, 2010, p. 1). The creation of artificial green surfaces on the roofs of urban buildings can make up for the shortage of green spaces in cities and can be regarded as an appropriate alternative. Green surfaces can also enhance the sustainability of the cities. The sustainability process can be regarded as a multi-dimensional phenomenon; that is to say, it can prevent the destructive biological, ecological and social effects and abnormalities as well as improving public welfare, economic status and maintaining social justice in urban areas. Since the proposed plan (green roof) is intended to preserve and improve the natural environment, it not only meets the needs of the present generation but also creates the background and facilities for meeting the needs of the future generations (Habib, 2007, p. 111).

## Theoretical Concepts and Principles

- Green Roof

Green roof is, indeed, a kind of roof which grows on the surface of plants (Razavian et al., 2010, p. 139). Green roofs can be created in two ways: extended and condensed. On

average, the extended green roof grows from 50 to 150 millimeters which is intended to protect plant life. The size of the plant should be limited so that it can grow on the roof and it should significantly increase weight of the roof. In general, much traffic and walking on the green roof is not allowed since its shallow and fragile root system can be damaged. This kind of roof is often installed on buildings which have an integrated and unified operating system. The condensed green roof, on average, grows from 150 to 1200 mms which can support larger vegetal surfaces. Larger bushes and even trees can grow on this variety of green plant. This green roof is of higher significance for aesthetic aspect of the buildings and is resistant against much walking. However, condensed roof imposes much weight on the roof which requires the application of further structures in the construction. Also, it requires deep layers and regular maintenance and repair (Kosareo & Ries, 2007; Mlineux et al., 2009).

Green roof or roof garden, indeed, refers to a designed green space which is established on unused and idle spaces of buildings, i.e. roof and terraces. These roofs are established based on modern technologies. Aesthetic, social and cultural values rationalize the installation of these roofs and they are intended to revive the lost green spaces in the modern urban areas, sustain the environment and improve the physical, psychological and mental health of the citizens. In other words, they are aimed to enhance the standards and qualities of modern urban life. In fact, bringing plants to buildings is tantamount to the creation of green, beautiful and semi-public spaces for the residents of those buildings. Thus, the quality of life (in terms of satisfaction with the environment) will be enhanced (www.chekadeno.com).

- The Background of Green Roof

The construction of green has an ancient background and dates back to the seventh and eighth centuries BC. The Asian civilizations which developed at the bank of Tigris and Euphrates were the first peoples who created this art. The most famous green roofs were the hanging gardens of the ancient Babylon. Afterwards, the green roofs were scattered in different areas of the world such as Scandinavia, Turkey, Iraq and Iran. The combination of mud and soil were used as traditional materials for building roof in the above-mentioned regions. These materials included grass seeds and self-growing plants which began to grow and create a green and favorable bed (www.30vil.net). Modern green roof which are made of a system of prefabricated layers are considered as a novel phenomenon. These roofs were originally created in Germany in the 1960s and then were used in other European countries. According to the recent estimates, about 10% of the roofs in Germany are green. The United States of America also has considerable green roofs but the number of green roofs in the USA is less than those of European countries (www. pejvaksokhan.com). In Iran, the available spaces in roofs are often regarded as unused spaces which are not regularly used for specific functions. These spaces are always exposed to sunlight. In case plants are grown in these spaces, one can have access to them at any moment. Thus, green roofs not only lead to the development of architecturally aesthetic environments but also they help realize the standards of green spaces. Every square meter of green space which is added to residential environments can reduce a significant amount of weather pollution from the urban areas. In addition to primary needs such as shelter and housing, human beings need to have other things such as clean air, sunlight and mental and physical health. However, with respect to the present circumstances in modern cities, achieving the above-mentioned requirements seems almost impossible. Nevertheless, growing plants on the roofs does not occupy significant amounts of useful grounds; rather, they can create a relaxing space for the residents of houses. There is a lack of enough green spaces since the area of green spaces is low and these green areas are not fairly distributed in downtowns; hence, they cannot respond to the spiritual and physical needs of the citizens and the link and association between the

nature and human beings is gradually neglected. This problem has attracted the attention of many great theoreticians and researchers.

- Plans for Utilizing Urban Lands and Develop Green Urban Roofs

Making plans for using the urban lands and roofs are regarded as a series of purposeful projects which organize and improve the artificial and human-made spaces; they are intended to accommodate the needs of urban communities with regard to using lands and earth surfaces (Pourmahamadi, 2008). Related urban planning is concerned with how to create green environments and how to distribute, protect and organize them. It also evaluates urban operations and activities. In fact, green urban spaces are regarded as applications and uses of the urban land on which humans conduct some operations to develop vegetal areas. These green environments are designed to have social efficiency but not residential and civil efficiency. According to the viewpoint of urbanization, green environments constitute a significant part of the appearance of cities which are made of a variety of plants and vegetations. They are considered as an alive and critical environmental parameter which are located and integrated with the lifeless body of a city and determine the form and structure of the city (Nadernezhad et al.,2009). At the outset of the new millennium, the loss of the association between human beings and nature is regarded as one significant factor which has deteriorated the living conditions in urban regions and has led to a crisis in these regions; the isolation between nature and humans has made the appearance of cities ugly and disorganized; hence, citizens have become soulless, bored and resented. This gradual loss of humans' interest and passion for natural environments has been ignored. Researchers contend that one of the major methods of managing urban crises is to strengthen the relationship of urban residents with nature and enhance their interest in natural environments (Zangiabadi, 2009). Cities which have desirable and beautiful sights and locations are able to extend aesthetic intelligence and experiences of the citizens and can improve their visual imaginations and impressions about the society. Such cities can increase the citizens' civil pride. The created green and natural environments can promote the reputation of the cities at the national and international scopes and enhance their competitive capacity for attracting investment and talented human forces (Golkar, 2008).

Inasmuch as the population and pollution in urban regions is remarkably increasing, the important contribution of green environments in dealing with these problems should be clearly highlighted. Green spaces play the role of a natural cleaning filter which eliminates some of the urban pollutions such as smoke and noise. It relatively guarantees individual and social health of the citizens and provides tranquility and peace for urban environments. The per capita area dedicated to green spaces in European cities is as follows: Paris 5.25 square meters, London 9, Berlin 13 and Vienna 25 square meters for each person. The standards for determining the per capita of green environments in developing countries are less than those of Europe and USA. The proposed standard for developing countries is 16 square meters. Nevertheless, the per capita green environment in Kolkata, for instance, is 1.2 square meters and 1.4 square meters in Bagdad. In the country of Iran, the proposed standard, on average, is 2 square meters in local parks, 1.5 square meters in regional parks and 4 meters for city parks (Pormohamadi, 2008). It should be noted that the global standard for green spaces is about 20 to 25 square meters for each citizen. Some informal statistics indicate that 8-9 square meters have been proposed as the per capita green space in Iran (Ibrahimzadeh, 2008).

Since some importance is currently given to protecting green environments and the problems of urban areas are increasingly escalating, hence, developing cleaner and healthier cities is considered as a priority. The problems arising from the increasing growth of urban population has eliminated the balance in terms of the existing green lands in urban areas and hence has damaged the ecological system. Therefore, the environments within cities have low ecological values; the pollutions of air, soil and water have isolated humans from natural

environments. Plants and natural animal habitats in the vicinity of cities have been destroyed. Even in recent years, climatic changes have been observed in some urban regions. The urban growth has had a significant negative impact on green environments; however, if green environments are properly distributed in urban areas, they can fulfill remarkable ecological effects. Sustainability is considered to be a critical goal and concern in urban issues and protecting natural environments and preserving ecology is deemed to be one of the important ways for achieving sustainability. Currently, the concept of *sustainability* is extensively used to explain a world in which human and natural systems are associated with each other and have mutual relationships with each other. This interaction between humans and nature is essential (Singary, 2008). The adequate existence of green roofs and green structural components within urban areas is regarded as critical which can be justified in various aspects and dimensions. For example, green environments can produce oxygen and reduce urban pollutions and change the lifeless body of cities into organic and alive bodies. The green roofs play the role of respiratory lungs for the polluted cities. In case urban regulations and principles are taken into consideration and moisture-proof insulations are used on the roofs of houses, the plants and green surfaces on the roofs will be able to make cities more and more sustainable. In Tehran which is regarded as an extremely polluted city, the pollutions of air, water and soil inflict 270 billion-Toman loss and damage every day.

- Criteria for Evaluating Green Roofs

Reliable and consistent criteria should be used to evaluate green urban roofs. The following criteria and standards can be used in evaluating and judging the values of green urban roofs:

1. Consistency: this criterion guides the positioning and establishment of green surfaces on the roofs of city houses so that green spaces are compatible and consistent with the surrounding areas. According to this criterion, they should not cause any disorder and interference in the function of the buildings and residential units which have green roofs should be distributed properly in the polluted areas; that is, all green roofs should not be placed near each other.
2. Comfort: the citizens' comfort and relief is defined according to their accessibility; the time and distance required for having access to the urban services and facilities. The construction of green surfaces on the roofs of houses creates the opportunity for its residents to have access to it at any time they wish.
3. Efficiency: in case the areas on roof are used for creating vegetal and green surfaces, the will be no concern for the efficiency and use of urban lands and areas. That is, if green roofs meet the need for green environments, other urban areas can be efficiently used for other useful functions. In the past a few years, one of the challenges in major cities of Iran has been that farmlands and gardens have to be changed into commercial and residential locations. It is argued that green roofs can result in more efficiency in using lands and prevent the change of functions in farmlands and gardens.
4. Desirability: the creation of green environments which are readily accessible for its residents can achieve the desirability and favorability criterion and satisy the residents.
5. Health: in addition to the aesthetic function which these roofs are intended to achieve, they should improve the citizens' health, and enhance their relief and mental relaxation and health.
6. Safety: According to this criterion, green roofs should contribute to the safety of the residents of houses and urban areas. That is, in addition to improving and optimizing urban views and prospects, these roof should protect the citizens against UV rays and preserve water resources and weather conditions. In brief, green roofs should contribute to the safety of the citizens.

**Conclusion**

It is obvious that the population of cities rises every year and this will result in more application and use of urban lands for residential functions. As discussed above, the disappointing fact is that the per capita area which is dedicated to green spaces is far less than the actual needs of human beings for green environments. This is partly due to the prevalence of apartment life in urban areas. Urban residents are used to living in small apartments. In Iran, the per capita area dedicated to green urban environments is supposedly 8-9 square meters. Nevertheless, due to the inflation in housing price, residential buildings become increasingly smaller and cramped. Thus, the cities become more dismal and chaotic places for living. That is, in terms of architectural considerations and city appearance, different and contrasting colors and materials are combined and used which reduce the aesthetic values of cities. Furthermore, green spaces are not evenly distributed in urban areas which threatens the physical, mental and psychological health of the residents. With respect to the primary needs of human beings, people not only need to have a shelter but also they need comfort, peace and ease in their shelters. The policy and strategy proposed in the present study is to utilize building roofs which are known as *green roof* or *roof garden* in architecture. They include layers and surfaces of plants and vegetal coverings which grow as a function of climatic conditions. In this paper, the researchers suggested six criteria for evaluating and gauging green roofs, i.e. consistency, comfort, efficiency, desirability, safety and health. These criteria are of high significance in urban planning and operations which are extensively used to measure the value and quality of the projects. If green roofs assume consistency and provide comfort and health, they will be able to produce favorable and pleasant breathing space for the residents of houses in urban areas.

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