



The role of green roofs in sustainable development

Fatemeh FOTOUHI

Department of Architecture, Yazd Branch, Islamic Azad University, Yazd, Iran

Received: 22.03.2015; Accepted: 29.05.2015

Abstract. Nowadays, due to this fact that city and urbanity have been increasingly expanded, the destruction process of urban green space is developing with more speed which this process makes numerous problems among which we can refer to increase in level of air pollution, reducing urban landscape, increase in respiratory diseases, etc. The green roofs, the gardens which are built in the houses' roof instead of the land, nowadays have been replaced with urban green space or parks in most of the advanced and overcrowded cities which are faced with shortage of space because of increased construction and reduced surface of land. In this article, first sustainable development, urban green space and its role in sustainable development have been defined and then the green roof and its types and components have been studied and finally two sample of types of green roof have been compared.

Keywords: Green roof, Sustainable development, Urbanization development

INTRODUCTION

Through the acceleration of industrialization and replacement of machinery and roads and manufacturer at the expense of destruction of urban nature, urban green space development and its equitable distribution in sectors especially in city centers in the manner that it fits with urban construction, is considered as one of the main challenges of contemporary metropolis. The increasing development of cities in all the countries of the world including Iran, is inevitable consequence of knowledge and technology era. Urbanism growth and development has a direct relationship with urban frame expansion and it leads to being away from nature and cutting the relationship between human and natural environment. (Moharram Nejad and Bahman Poor, 2009). Green space is a part of urban physical expansion which it can has a determined functions. The green space has accepted sometimes the decoration role (urban view beautification) and sometimes it has an amusement role (recreational), but through increasing development of urban sections in recent decades and taking the lead of urbanism on urbanization which encounter with numerous problems such as irregular increase in population, non-targeted physical development of cities and increased environmental pollution. (Mohammadi, 1994). The green roof is one of the new approach of architecture and urbanization and arising from sustainable development concepts which it can be used to increase green space's capitation, promoting the quality of environmental and city's sustainable development. The practical use of roofs can be considered as the optimal utilization possibility of urban land. (The Tehran's parks and municipal green roofs organization, 2010). Green roofs are known as the topics such as gardening on the roof, planting technology in roof, living roofs or green roofs or gardens. Green roof is actually a live ecosystem (2007, LID) which provides a desirable biological capacity for urban environmental and makes it more efficient and sustainable. (Ansari M and Keshtkar A, 2006).

Research's method

This research's method is descriptive- analytical. Its theoretical basics have been done according to collecting a part of research's data using documents method and by the means of books, documents, articles and publications in the field of urban development and sustainability of life and environmental urban green spaces.

* Corresponding author. Email: Mahmoudmoein@iauyazd.ac.ir

The role of green roofs in sustainable development

Goals

Because the main goal of urban planning is sustainable development of providing people's welfare and comfort, especially spiritual and mental comfort, so paying attention to urban green space as one of the factors of welfare and comfort has an important role in space desirability and amenity in the citizens' view. Therefore the final goal of this research is as follows:

The study and recognize the important role of green spaces in order to achieve the goals of urban sustainable development.

SUSTAINABLE DEVELOPMENT

The subject of urban sustainable development is one of the main topics in contemporary urbanization which it has attracted a large part of scientific literature of urban development and also policies, planning and programs. (Rousta M, 2010). The concept of sustainability and urban sustainable development in cities are based on advocating of logic and ecological, economical, political, social, cultural and spatial dimensions and the contrast of these dimensions. (Ziari K and et al, 2009).

The features of Sustainable development

Summarily we can refer to these cases: 1. saving in energy consumption. 2. reducing the distance between the place of work and living. 3. reducing the utilization of vehicle for business trips. 4. development of public transportation system and pedestrians access. 5. Maintaining the biodiversity and city variation. 6. reducing environmental pollutions. 7. One hundred percent recycling of waste and sewage.

URBAN GREEN SPACE

From the urbanization's viewpoint, urban green space is a part of city's skeleton and morphology. In the other words, green space beside physical skeleton determine city's organ and generally its portrait . So, whenever city's designing has correctly accomplished, and it is carefully implemented, it is reasonable that a balance should be held among these two factors means inanimate and animate sector of urban morphology. (Hosein Zadeh Dalir K, 1994) . The purpose of urban green space is a kind of efficiency level of urban land or manmade herbal covering which it meet both social and ecological returns.

The urban green space is called to a set of open and green spaces which set inside the urban environment with specified goals, determined planning and functions.

(Matlabi m, 2004). The other definition is as follows: " urban green spaces are parts of widen or limited spaces in the city's functional range which they have been selected for the purpose of creating variety and beauty, improve life quality, providing human welfare and offering special services to citizens and they are under the human supervision and management. (Zarabi and Tabrizi, 2005).

URBAN GREEN SPACE AND ITS ROLE IN SUSTAINABLE DEVELOPMENT

Through urbanity expansion and making nature isolated, surely human and nature unity is manifested in the park, garden and urban and public green spaces and this point necessitates paying attention to sufficiency role of green spaces. Green space is a kind of efficiency level of urban land or manmade herbal covering which it meet the effects of external factors and their mutual relationship which leads to biological balance. Therefore, the manner of human's relationship with environment, the method of establishing communication and being impressive

of ecosystems' characteristics have an important and undeniable effect in mental and emotional quality, whereas they remind fundamental principles of some schools such as Chicago, idealism, culture-oriented, naturalism, philosophy-oriented and sustainable development theory. Locorbusier has respected very much to green spaces and he believes that from each ten unit of urban space for residence, 9 unit should be considered for green spaces. (Hekmati J, 1996). Consideration to urban green space category appear more important when we know that this urban efficiency is directly related to urban sustainability. Modern dimension of urban sustainability in heterogeneous and unstable modern cities, is social sustainability which it has mutual relationship with park's role in heightening citizens' coefficient of partnership acceptability. (Mohammadi J and et al, 1997). In total, on the 11 century onwards, garden designing in the world and a holy place was accepted in designing peoples' daily required green space and some different thoughts and beliefs were shaped around it. (Behbahani, 1994). In Iran, green space architecture, especially garden building are, has a long history, so that in authentic scientific resources, the Iranian garden building has been reminded as one of the classic style and therefore Iran is considered as one of the stylist countries (Soltani M, 1996). The figure 1 is a emphatic on the role of urban green spaces in urban sustainability.

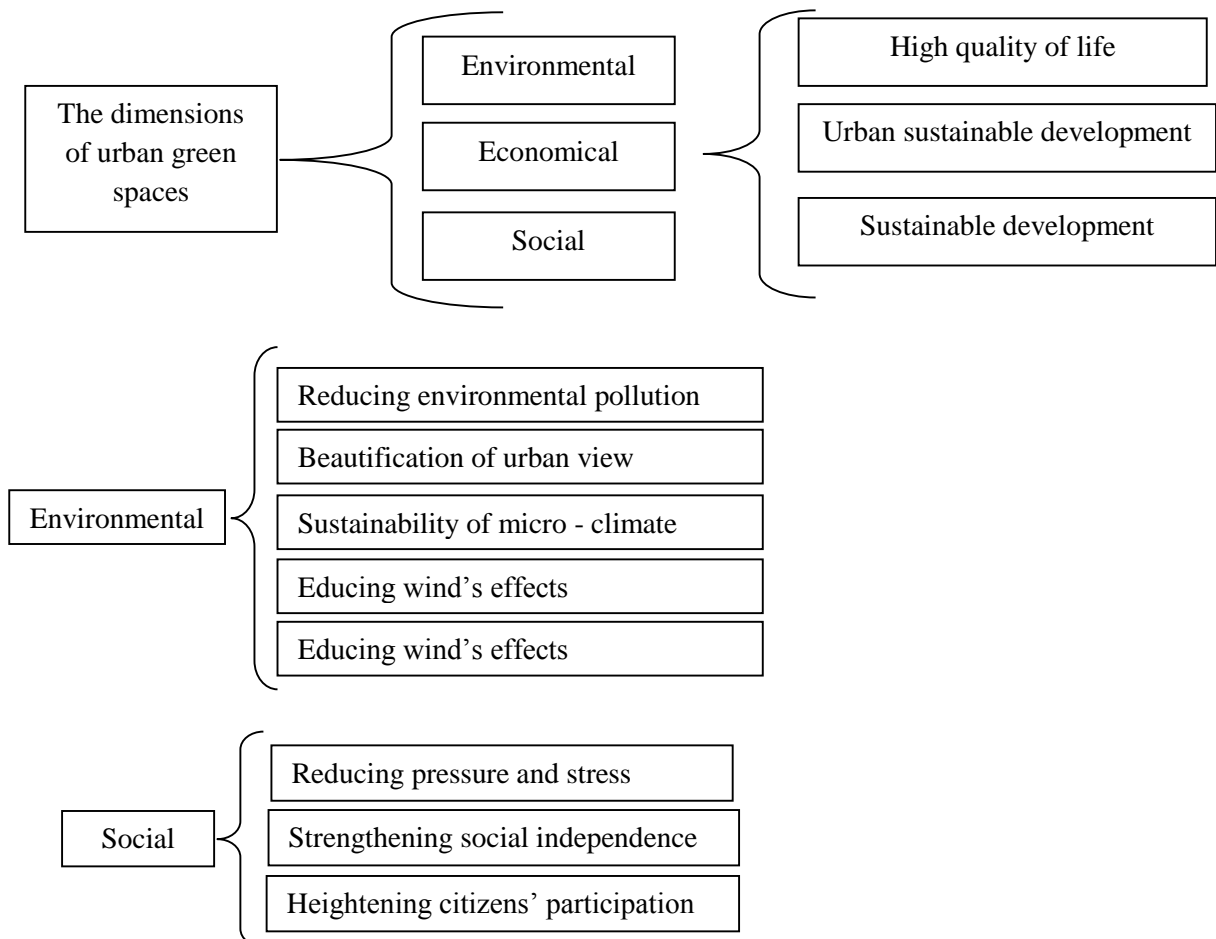


Figure 1. A emphatic on the role of urban green spaces in urban sustainability (Source: Mohammadi J and et al, 1996).

GREEN ROOFS

The green roofs, the gardens which is constructed in roofs instead of surface of land, nowadays they have been replaced with urban green space in most of the advanced and overcrowded cities of the world which they are faced with shortage of space because of increase in construction and reduction in land surface and they have been created with the purpose of environmental and

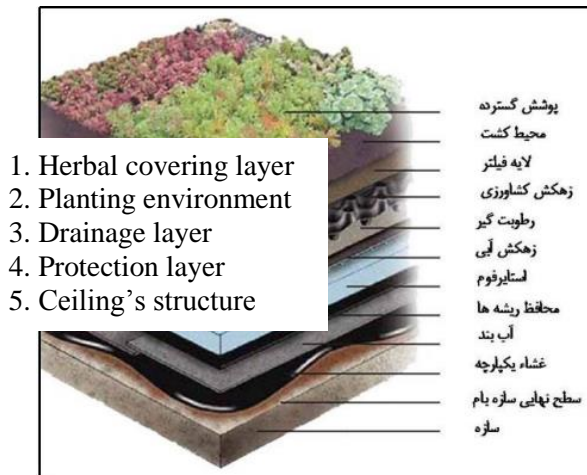
The role of green roofs in sustainable development

economic health and surface drainage amendment management in city and respecting to aesthetic issues. (Sayyad A, and Maddahi, 1997).

Green roof which is called plant roof or biological roof, is a engineer made lightweight system which makes plant growth possible in roof and yet it protects roof and they are also created in buildings' roofs by adding layers which have the ability to grow the plants. (Velazquez L, 225).

General components of green roof:

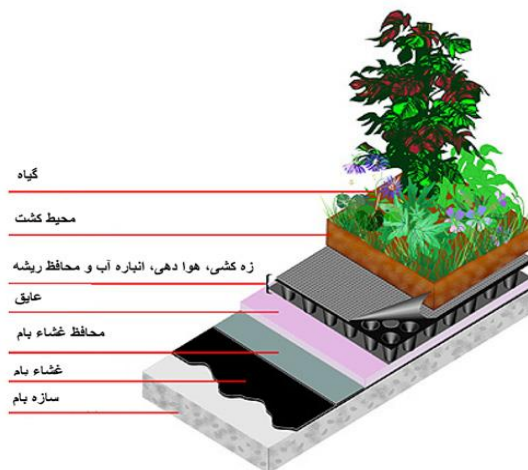
The green roof's components can be classified into 5 categories.



(Figures 2 and 3)

Herbal covering layer

Selecting the type of herbal covering depending on weather, structural designing and maintenance cost and roof designer's imaginations is faced with some restrictions. Because the green roofs are designed as lightweight as possible, they are usually consisted of a coverage which can grow in little depth of soil and with a little care and maintenance or without it.



Cultivation environment

A Cultivation environment should be used which is as lightweight as possible. According to building's national regulations, accountant engineers are obliged to predict a weight of 150 kg per square meter of building's roof, while green roofs are created a maximum load of 80 kg per

square meter in moist status which this number will eliminate concerns. A typical suitable mixture which is composed of 1.3 of sand, 1.3 of riddled stones and 1.3 of artificial humus (a combination of rotten wood and vegetable fertilizer) . 80 mm vegetative inductor from Granular coating materials , prepare vegetative Granules of roof to receive Sodom cover when Sodom sprouts are sprinkled on it or when Sodom mat are flattened upon it.

Drainage layer

It consists of 35-50 mm of Poly Ethylene (accessible recyclable materials) with fiberglass. The drainage layer are placed between planting environment and protection layer in order to enable water to flow from every point of green roof to building's drainage system.

Protection layer

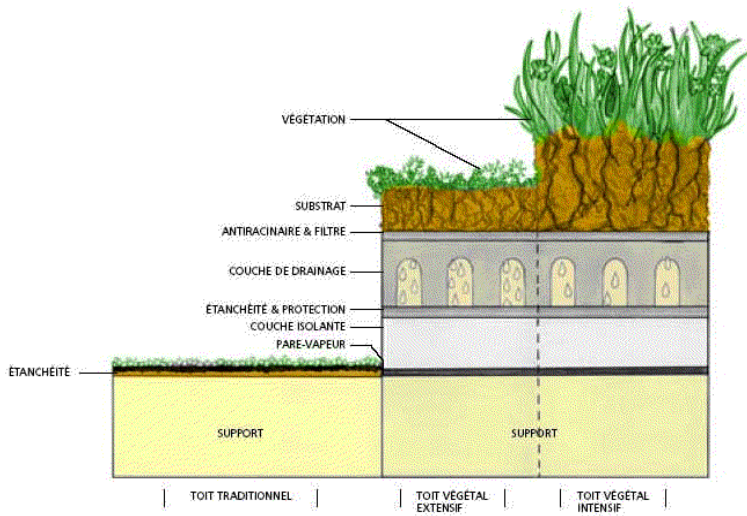
This layer is rather included the layers which protect roof from seeping or water leaking or they protect from insulation system.

Ceiling's structure

It protects roof from seeping and leaking. The membrane is used as a waterproof integrated layer and also as joint sheets (Luckett, 2009 - Monica E. Kuhn, 2002).

Green roofs are divided into three main categories according to executive system.

- 1.Intensive 2.Extensive 3.Modular or plant box



Modular or plant box
Typical roof- extensive green roof- intensive green roof



Intensive green roof

Extensive green roof

Figure 4

In continue, the advantages and disadvantages of intensive and extensive green roof have been studied. (Table 1)

Roof type	Some features	advantages	disadvantages
Intensive Green roof	-Deep soil, -owning watering system, -it is appropriate for planting more plant	-More variation in using plants and place of residence -Having high quality insulation -It can be similar to a garden -It is usually accessible -Various utilization of roof. (for entertainment, Growing edible plants, Open space. -It is very suitable for providing the goals of passive defense.	- Reload much weight on the roof and subsequently on building structure -It requires very much watering and drainage and water, material(suitable soil) supply systems . -It is costly - It requires completed and professional systems for creating and maintenance.
Extensive green roof	-Little depth soil, -without watering or by little watering, -It is not appropriate for any kind of plant	Little weight on the roof -It is suitable for some surfaces with Zero to 30 degree slope -Little care and maintenance -They are usually lack of watering and drainage systems -They require low skill and expertise -It is applicable for existing buildings due to light weight -It is easily Customizable for creating and maintaining in different conditions - It is very suitable for providing the goals of passive defense.	- Restriction in plant selection - It is not usually suitable for entertainment and other application -It has not a beautiful look, especially in Winter

SUMMARY AND CONCLUSIONS

Through taking into consideration some things like environmental threats in big cities such as air pollution, emergence of urban thermal island phenomenon, energy crisis, etc. germinating roofs has been considered this time because of their environmental benefits and as an ecologic solution. In spite of green roofs’ extensive environmental benefits, high executive expenses of installing and launching, watering and preservation and maintenance of these kind of roofs’ green space and briefly, economic issues prevent that this technology find its deserved position in contemporary sustainable cities. Green roof were germinated in last century because of application benefits and today they are germinated because of their environmental benefits. Through emerging of these two ideas and adding innumerable benefits due to making these spaces functional, local governments can take steps in the course of green spaces’ sustainable development and urban sustainable management. This application can be coordinated with building’s application. If the building is governmental, its open space can be used along with local needs or in a big measure city’s need. with respect to fundamental difficulty of most metropolises related to urban green spaces’ development and just classification and distribution of local green space fit with urban construction, practical application of roof as private or public green space has been considered as an effective step toward development and increase in per capita green space beside citizens’ place of work or living. And it creates a safe green space for people of society, especially for older ones and children beside their place of living.

REFERENCES

- [1] Ansari M and Keshtkar Ghalati, 1996, The study of challenges and effective factors in failure to expansion and development of green roofs in Iran, International quarterly of road and building, NO 62, pages 55-6
- [2] Behbehani Homa, 1994, The assessment of Tehran's parks until determining pattern, scientific-training quarterly of green space, NO 8
- [3] Hossein Zadeh Dalir Karim, 1993, The application of urban green space in comprehensive plans and the principles of park designing, Geographic growth journal
- [4] Hekmati Jamshid, 1992, Designing park and garden, comprehensive culture publication
- [5] Rousta Mojtaba ,1990, the investigation of maintaining and preserving condition of green roof. (garden). Jahrom city, in line with sustainable development, Master Thesis of Mashhad Ferdosi University, Geographic group, supervisor: Dr, Mohammad Rahim Rahnama
- [6] Ziari Keramatollah and Mahd Nejad Hafez and Parhiz Faryad, 1989, Basics and techniques of urban planning, Chabahar International university publication, First printing
- [7] Tehran's parks and green space organization, 1990, vertical development of green space "green roofs". General Staff of vertical development of green space, Tehran's municipality
- [8] Saeed Nia Ahmad, 1980, urban green space, municipality's green book, publications of country's municipalities organization
- [9] Soltani Mehrdad, 1987, formation of urban gardens in contemporary period: pass through the concept of garden to park.(focused on Tehran's experiences) view garden, fourth years, NO 8
- [10] Sayyad A and Maddahi M, 2011, sustainable architecture, first printing, Tehran, Otes publication
- [11] Zarabi Asghar and Tabrizi Nazanin, 1988, optimal planning of urban green space , east chlorophyll quarterly,
- [12] Moharram Nejad Naser and Bahman poor Hooman, 1991, the study of effects of urban development on Tehran's green space and offering managerial guidelines, environment technology and science journal, 11th period, No 4, pages 523-531
- [13] Matlabi Mohammad, 1986, criticism on women's park project , green message journal, No 3
- [14] Mohammadi Jamal and Mohammadi Deh Cheshmeh Mostafa and Yegane Mansour, 1987, qualitative assessment of urban green spaces' role and optimization of citizens' utilization of it in Kurd city, ecology, 33th years, No 4415- LID.2007. Green Roof – Design Page, Low Impact Development Centre, U.S.A., Cited on 22 August 2010, http://www.lid-stormwater.net/greenroofs_home.htm.
- [15] Leed AP, Kelly, 2009, Green roof construction and maintenance.McGraw, Hill's Greensource .Lockett series,208pp
- [16] Monica E.Kuhn, 2002, Green Roof Infrastructure Workshop, Canada Mortgage and Housing Corporation, www.cmhc.ca.
- [17] Peck,S.W., C.,Callaghan .1999. Greenbacks from the Green Roofs: Forging a new industry in Canada.
- [18] P&A Peck and Associates, for CMHC/SCHL Canada.
- [19] Rahnama, et al. 2005. Accessibility and Sustainability in Sydney, International. Conferences of Health Risk. Blonya, Italy, 356-370.
- [20] Velazquez, linda s,Environmental quality Management, (2115), organic green roof architecture, sustainable millennium, The green roof projects database, design for the new.