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Using Green Space in Buildings and Structures for Optimal Energy Management

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ABSTRACT

With increasing urbanization diminishing of natural resources is rapidly happening. Therefore, the use of green space in today's construction is remarkable in many ways and can compensate the damages caused by unbalanced development of urban life and its environmental damage. Urban parks, internal green spaces such as green roofs play and important role in energy consumption and it management in addition to social and aesthetic dimensions. In this research whatsoever is used in buildings and constructions about the advantages of green spaces is named and is studied in the energy management and exploiting. The base of this research is reviewing articles, books, online resources and implemented projects in the world. The proposed strategy is using the experience of developed countries in using green space to promote building's environmental quality as well as using the technology related to its circumstances and operational methods to found the possible optimal factors in management of the energy used in the buildings.

KEYWORDS: green space, energy consumption management, building, structure, sustainable development

INTRODUCTION

Today, the use of clean energy and attention to the environment and its inhabitants in an unlimited time span is necessary. In Germany, an estimated 10% of homes directly enjoy the green space such as green roofs. In Tokyo, the program of Tokyo 2000 started in April 2001. In this program the usable space of the new buildings with an area of over 1,000 meters should have 20% green space. Green roof in North America in places like Chicago, Portland, Oregon and Toronto in Canada have been effective and are considered. In Chicago, where 20,000 square foot of green roof is located at the top of its municipality, the energy storage law was passed in 2002 and it was appointed that new construction must have green roofs or reflective roofs. In Vancouver the collective concern is instability in two field of energy consumption and wastewater and experts have detected that green roof technology will help to solve these two issues. According to the environmental effects and diversity of animal species, green roof will have positive effects on the environment. Decrease of pollution of wastewater and increase in the necessary oxygen for humans are among other positive effects of buildings' green space. Since the ancients have used the benefits of this potential, using it in the urban environment while absorbing noise and cooling will reduce the energy consumption. Residents of buildings with green roof with production of plant food and soil stabilization provide a stable system. Search and investment in green roof technology is the best method that let our cities to grow and develop to ensure the survival of mankind and the environment. It seems that the time has come when large-scale Iran cities such as Tehran, Mashhad, Isfahan, etc. should take steps in this direction.

Problem Statement and Purpose

Private sector developers for reducing their costs and gain more profits in their constructions, add the percentage dedicated to green spaces to the total infrastructure in different ways and meanwhile construction of parks and residential buildings with green natural scenery in large scale seems not possible with this rapid development of large cities (Mahmudi and Pakari, 2012).

High value added and low area of green space has led to the use of green roof technology in metropolises in Iran due to the improvement and sustainability of environmental quality, seems relevant. Environmental problems are one of the major problems of today's cities and are a result of aggression and oppositeness with the natural environment, because urban development inevitably is accompanied by dominate of buildings, industries and transport and economic activities on the natural spaces and this oppositeness has changed to dominance of city over the nature and

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has underlies wide urban pollutions. The result of this process will be imbalance and conflict between human and nature and disturbing the ecosystem relations.
As cities expand, the symbols and values of the natural environment has been further endangered more and burgess are deprived of natural attractions and psychological and social problems are manifested. Population concentration in urban and rural areas of towns and the mismatch between the growth of urban services and infrastructures especially in developing countries has changed the urban places to unsanitary and polluted places and faced with sewage and waste disposal and sanitary water supply problems (Salehi, H., 2001).

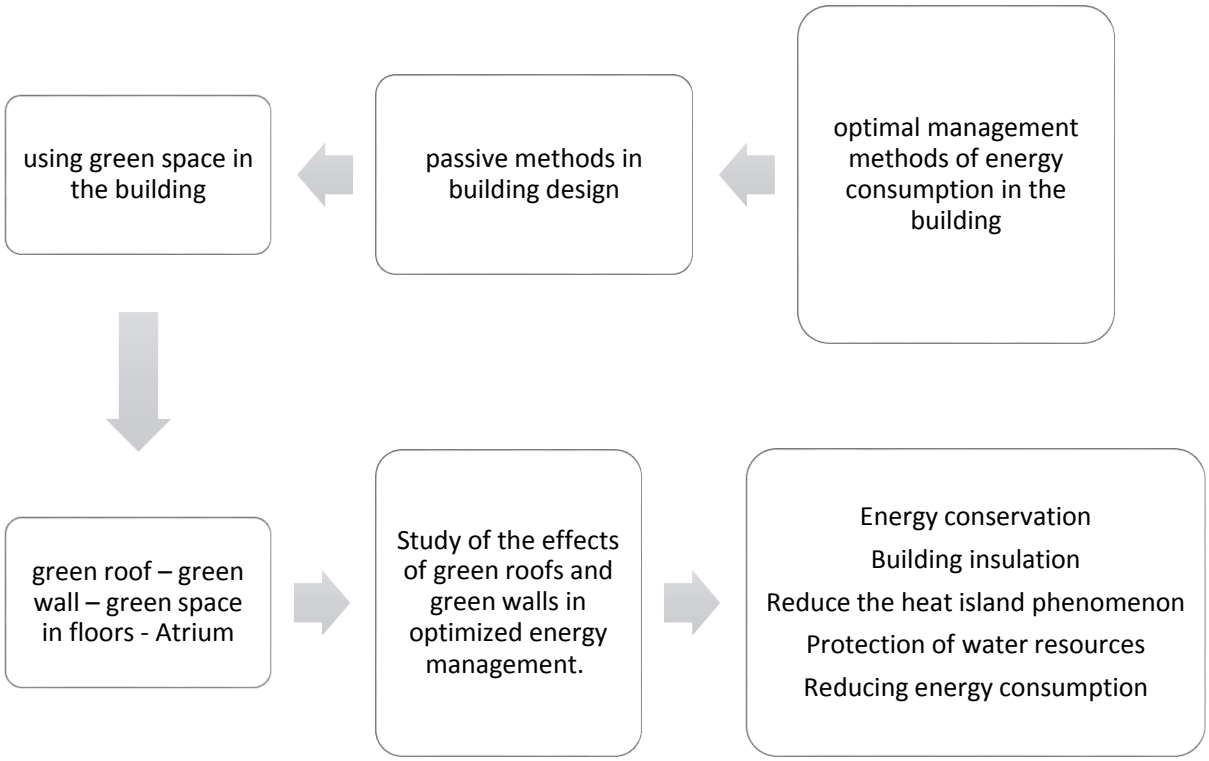
Energy consumption of residential buildings (KWh per square meters in year)

energy consumption of residential buildings in decades 1960 and 1970	300
average heating energy consumption of residential buildings in 2002	160
insulation criteria of year 1995 (until January 2002)	54-100
low energy buildings	55-70
passive buildings	15

Reduce the energy consumption of buildings is not only through the use of appropriate materials and building installations, but also it is possible to reduce the building consumptions with an urban design and architectural design appropriate to the climate.
Nasrollahi, (2012) in his studies in the field of architectural design rules and patterns to reduce building energy consumption proposes the major architectural factors affecting the building energy consumption with the following titles:

- Thermal shell of the building
- Heating, cooling and ventilation of buildings
- Architecture and building form

In this study the following process will be brought according to existing information and backgrounds in order to achieve the objectives of the paper:



Research Questions

What is the effect of plants on buildings?
How can help to improve environmental quality with green space through structure?
What is the effect of using plants in improving the quality of the air outside the building and environmental quality?
What is the role of plants in urban sustainable development?

1- Optimized energy management with the approach of sustainable development (green building):
According to ecological limitations and environmental impacts, any step of city development and any aspect of urban design, from saving in building's energy consumption to regional transport network and circumstances of commercial and industrial sectors' operation should be concerned (Designing America, 1995:156).
A stable society considers main ecological limitations, seeks social stability and qualities of life, use comprehensive solutions, is based on justice and quality, emphasize on importance of societies (collective life) and requires and encourages accounting of all social and environmental costs due to private and governmental decisions (Selman, 1955:33). In order to achieve sustainable development environmental goals, the following four strategies should be followed:

1- Utilizing and stabilizing the consumption of sustainable resources or those -which have the capability of sustainability.
2- Optimization and audit the use of non-renewable resources and minimize the consumption of natural resources according to their natural growth
3- Minimum generation of wastes and pollutions that be absorbable in the local and global environmental scale and capacity.
4- Creating a healthy environment for future generations, and meet the basic needs of man and society (Edwards, 1999).

According to Panahi et al. (2006), the environmental aspects of sustainable development is accounted as follows:

1. Preserving the natural ecosystem balance
2. Combination of development issues with natural ecosystem
3. planning and natural management
4. Efficient use of water, soil and energy resources
5. Replacing the renewable sources
6. Disaster Planning and Management
7. Environmental pollution control

According to studies done, the environmental dimensions of Disaster Planning and Management in a proposed analytical model is divided in 5 main branches (Figure 2).

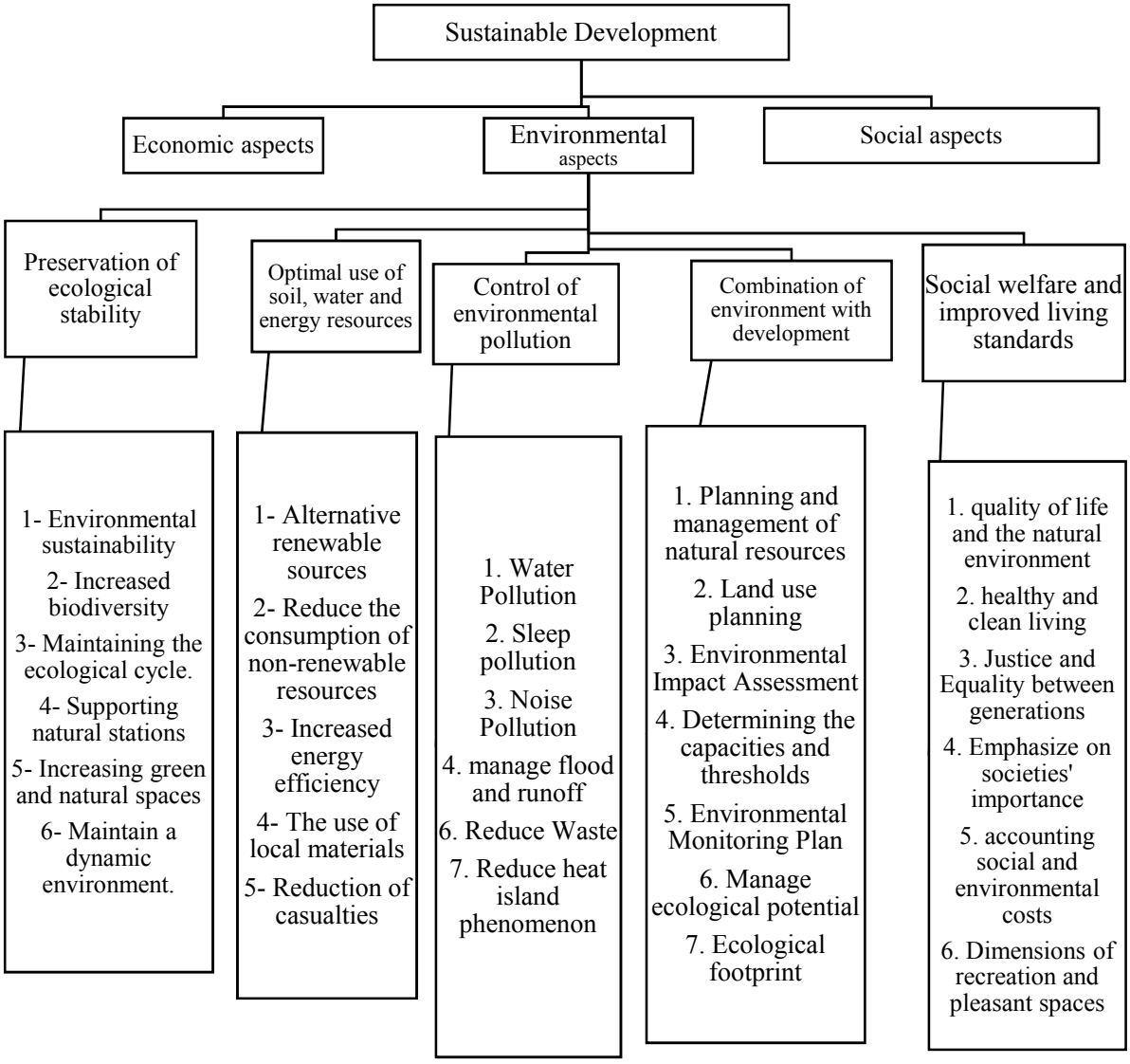


Figure 2. Proposed analytical model of sustainable development environmental dimensions

2- Management solutions of energy consumption in buildings

In line with this approach we can classify the general framework of energy consumption optimization actions as active, passive, using especial materials in detail design and also using related tools and standards with energy consumption (Brian 2010,34).

2-1 Active method:

In this method different types of renewable energy according to existing conditions is studied to find an alternative for un-renewable energy sources and fossil fuels. Renewable energy sources are considered as an essential component of sustainable development and in certain circumstances they can be used effectively in urban environments. Renewable energy are used for the production of mechanical and electrical forces and also heat. Use of this kind of energies which include solar energy, wind energy, water energy, energy related to central heat of the earth, biofuels, tidal energy and wave energy are expanding rapidly.

2-2 Passive method

This method explains the optimal design and harmonious with climate and attends to the existing potentials of the environment and design including how to use sun radiation or arrange internal spaces and attain the climate goal designs in the best way. In this method optimal consumption of energy is using design methods and basic principal, and using natural materials is for achieve comfort and to some extent is accordance with traditional methods that have been used for centuries and its most important principle is the building orientation relative to sun in the desired area. In fact this method offers advices on building design. So building architecture design should be as much as possible compatible with the climate, so that the building take advantages of the desired situation and facilities and be protected against the undesirable climate situation. Thus, according to what is described in the definition of passive methods of fuel consumption management in buildings, using green spaces in the building and structure can be accounted among the passive methods of energy consumption management in architecture.

3- Green space application in architecture

Gardens and trees in harmony with the climate in any region have been very effective in creating comfort. For example, in desert areas along providing shade and beauty trees compensate the poverty of humidity. The green surface with absorbing solar radiation prevents repeated reflection of rays and unwanted increase of heat and also reduce the unwanted reflections and increase re-rays are heat and dust around the building to reduce the dust around the building. For example in the homes located in Broujerd, green space are as wide surfaces that are located in the central yard. These green surfaces in addition to visual beauty, cause an increase in the humidity and absorption of solar radiation and get the heat of the desert winds via vaporization and play an effective role in cooling the air.

Green architecture is known with the term "sustainable architecture "; a macro term that deal with expression of techniques in architecture that is in line with environmental views and is shaped with the idea of respect to nature. Today, in the wake of the negative consequences of the industrial world, such as air and environmental increasing pollution, depletion of natural resources and energy crisis, protection of world's natural resources has become one of the most important concerns of the present man. But green architecture in fact with the search of a way to minimize the negative effects of buildings on the environment is an effort for unison and harmony with the nature via increasing the efficiency and optimizing in materials consumption, energy and space expansion by harnessing solar energy and using heat-resisting structural elements such as additional ventilation floor and cooling the floor, this huge project will be stepped cautiously into the desert kingdom. In areas around the city that is located 20 miles from the center of Abu Dhabi, photovoltaic and wind power plants, research centers and farms are placed that provide the fuel of the city's factories. These farms also help to reduce waste because balances the gases from factories via carbon capture and will be irrigated with city's waste water.

	Vast vegetation **Growth Materials** **Treatment System** **Drainage layer** **Wet coating** **Aluminum drainage** **Styrofoam** **Root Stopper** **Soft wire** **Integrated shell** **surface softener** **Undercoat**

4- Variety of solutions in using green space in buildings and structures

Buildings which are made for shelter for humans, should benefit the best adaptation to the environment. The key to sustainable life is started from decreasing disturbances which its origin is the human being on earth, and this is not possible without the increased presence of natural elements in his life and more coordinating human with the nature. Cities as centers of human activity and life to be able to set their sustainability have no choice but to accept structure of and functioning affected by natural systems. In new scenarios a two-way relation exists between the human and environment that human climate nature (with the design and construction of spaces) and human activities both interact each other. Because the man lives and finds herself in it.

3-1 Green roof

Another tool is green roof that is used to reduce the heat around the cities which this reduction if the temperature in summer months leads in reduction of the demand of electricity. During the winter months green roof can be an important agent and provide reduction of thermal energy demand.

Green roof is in fact a roof that plants grow on its surface. Plant diversity of such a structure can be covered with artificial grass to garden roof covered with plants used in landscape design. Covering the roof needs plants that are selected carefully to resist against drought, climate factors, freeze of sea breeze, dry, etc. in the harsh environment of the roof. The type of plants vary depending on the type of weather and climate conditions. Green roof or roof garden is the peak of combination of execution with environment. Executive details of such a roof is not much different form ordinary roofs and include thermal insulation, waterproof coating, sand and base flashing and besides it exist materials and elements to provide maintenance, drainage of humidity and tools of maintaining plants (as standard) on the building.

Green roofs are an accepted element in modern buildings, where some cities or even governments have necessitate their usage. Roof garden presents from about 40 years ago on the roofs of the houses in Europe and are created in cities because of direct interface with temperature and preventing of heat island formation. Limited land resources, expensive energy resources, old sewage systems and the need for a new source of energy recycling in greenhouse are involved in the success of green roofs in Europe. Only in Germany as the leading country in this industry, more than 800 samples of standard roof gardens is found. World Standards of roof garden from this country goes to the whole world. Municipalities of this country run the rules of building and executing of roof gardens from the beginning of structuring the building. Roof garden industry in Germany have had an annual average growth of 15 to 20 percent since 1982. In America, green roofs are constructed with a steady increase in comparison with the past. Several companies and associations in the North America also have begun practices of green roof, because they know that even if green space be expanded on the Earth, it will not answer the needs. The new World Trade Center in New York in its final confirmed design will have a garden roof over its head. Le Corbusier and Wright have been the pioneer naturalists and creators of green roofs in the 20th century.

Types of Green roof

A) Intensive roof gardens

In this type of roof garden, also called the Rooftop garden, the roof is accessible and can be trees, bushes and other elements of the park. This system is called deep section or garden roof that is a kind of green roofs including different types of vegetables and is designed like a park. Some green roofs have large trees and a fountain that this issue needs strengthen of its basic structure.

B) Semi-intensive (combined) green roofs

This is a combination of intensive and extensive roof. It has the benefits of two mentioned roofs, but has greater load capacity. Growing is done in the wide lightweight panels and its deeper planted layers has increased the possibility

of species diversities such as the use of permanent grass and bushes, but trees are not present in it. In this type of garden roof, the surface of the roof are not accessible and its facing is visible from surrounding buildings. This type of roof garden have a shallow bed planting cover and its species are mostly cover crops. This system is called low height section or thin enforcement that contain one or two types of plants and usually this system is used when the minimum weight is desired. In particular, the only maintenance staff have access to this type of roof. This type of roof, like Norwegian grasses is constructed on flat and inclined roofs.

3-1-1 Green roof and optimal energy management

Green roof is known with titles such as gardening on the roof or garden roof. In fact that is a live ecosystem that provide better living for the urban environment and make it more productive and more sustainable (Ansari, M., and Keshtkarghalati, 2006).

Black surfaces of roofs and paving absorb and accumulate the energy from sunlight and reflect it at night. In this regard, green roofs can reduce negative effects on the buildings in the local ecosystem and then reduce energy consumption in buildings and have a certain positive role in the change of energy flows.

Table 2. Advantages of using urban green roofs

Dimensions	Advantages
Ecological	Conserving biodiversity and habitat creation
	Improve the urban ecological - biological qualities
Climate	Adjusting the effect of the city's heat islands
	Cooling effect
	Reduction the effect of cold wind and heat insulation
The quality of the urban environment	Improving air quality (refining aerosols)
	Exchange of oxygen and carbon dioxide
	Reduce noise (sound insulation)
	Reduction of the rainfall runoff volume (surface wastewater protection)
	Improves water quality and prevent its pollution
	Reduction of the electro-magnetic radiation effects (up 99%)
Cultural – economical	Reduction of artificial ventilation costs (cooling in summer)
	Extending the operational life of the roof insulation
	Recreation and Health
	Increased sense of belonging to place
	Energy savings (covering insulation in winter)
	Creating additional green space

Reference: (Nahrli, D., and Bigi, V., 2011)

- **Saving energy resources**

Today, with the increasing growth of energy consumption in the world and due to the shortage of fossil fuel resources and severe environmental pollution caused by combustion, the necessity of using renewable energy has increased. One way to reduce the consumption of fossil fuels is making building blocks so that minimum energy be needed for heating and cooling (Chalfoun, 1991:56). Sunlight as the biggest available energy source that efficient use of it have not been possible by mankind (Nasiry, 2006:33). The importance of buildings with efficient energy consumption is no secret today. Due to the rapid depletion of energy resources, energy shortages and increasing environmental pollution, innovative solutions to end energy consumption is necessary. In modern buildings mainly the value of consumption energy in order to supply indoor environmental comfort has increased (Global Journal of Environmental research.2003:12).

The most important feature of green roofs is movement in the direction of ecology and nature. Green roofs reduce building energy exchange. In warm weather the temperature reaches 31 degrees Fahrenheit, the temperature of the roof reaches to 551 degrees Fahrenheit. Plants turn the soil's heat and moisture to moisture through evaporation that this process results in cooling the building. In cold weather the rate of heat loss depends on the moisture content of the substrate. On average an extensive green roof increases the insulation to 51 percent (Szewczyk, 2003:30). Green roofs can decrease the negative effects of buildings in the local ecosystem and subsequently the energy consumption in buildings and have a certain role in building energy flow changes (Dunnett and Kingsburry, 2004, 112).

- **Creation of heat insulation**

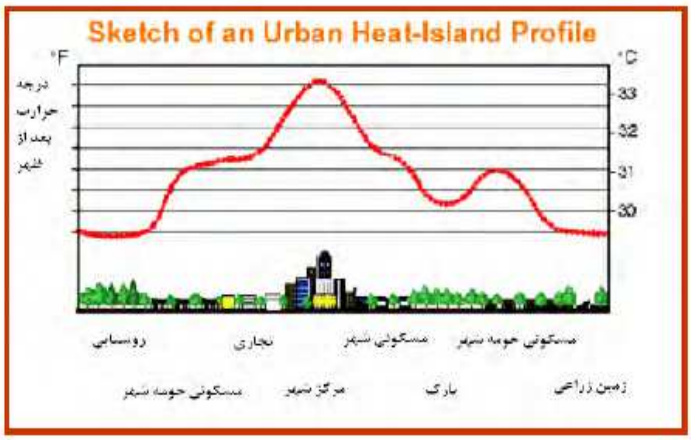
Green roofs cause energy saving via reducing the heat exchange through the roof. The amount of this savings in different months of the year and also according to the amount of water absorbed by it is different. In summer with the heat transfer from the roof into the building further cooling is needed. A roof garden prevents absorbing heat through roof in the summer by creating an insulating layer as well as a combination of plant and soil processes. Results of the researches in Chicago, America show that if all the roofs change to garden roof, one hundred million dollars energy will be saved yearly. The following table shows the results of a study at the University of Nottingham:

Table. Comparison of heat exchange in usual roof and garden roof at different seasons

Temperature	Summer	Winter
Daily average	18.4	0
An usual roof average	32	0.2
A garden roof average	17.1	4.7

- **Reduction the Effect of Heat Islands in Cities**

One of the negative consequences of development of dense cities is heat island effect. This effect is due to the difference of temperature between the metropolitan with the surroundings that this difference in major cities can reached up to 5 degrees. This effect is due to the absorption of radiation solar heat in buildings and urban expansion caused the air temperature in these areas to be significantly warmer than rural areas. Heavy use of fossil fuels have increased greenhouse gases and other pollutants that have a direct effect on global warming and pollution levels. Use of garden roofs to reduce the surface temperature to more than 4 degrees in tropical areas has been proven in an experiment at the University of Singapore. This temperature reduction is mainly due to the plants shadows and the cooling effect of their evaporation and transpiration on the rooftops. So green roofs can play an important role in reducing heat islands effect at the urban areas.



Temperature in Afternoon		Rural – commercial – Residential - Residential suburbs
		Residential suburbs – city center - park – farm land

Figure 1. Urban heat island profile

- **Saving Water Resources**

The issue of water and reduction of its use, especially in the present circumstances is important. Reducing water consumption is one of the main advantages of using green roof.

Green roof as the first layer on the ground stores water in its drainage layer and the stored water is delivered to the plants. Meanwhile, "in hot and dry areas which per capita water consumption in summer for building cooling is too high, green roof decrease water consumption by its effect on decreasing the building temperature and air adjustment (Bromand, F. 1991).

Green roots is designed such that its lower layer acts as insulator, drainage and barrier against the penetration of the plant's roots to the roof, accordingly the garden can remain fresh up to a month in the summer without watering. Maintenance and inspection period can be up to twice a month. Plants used in the roof garden should be resistant to drought and require little maintenance and should have the adaptability and matching to changes of soil. One of the most important effects of green roof is the ability to protect and maintain rain fall water during flooding caused by heavy rains that plays an important role in protection of water resources and reducing its pollution.

- **Reducing Energy Consumption**

Trying to build anything with few tools and consuming enough time is such important that the product should not be wasted. Therefore, any product made by human hands until his exhaustion must be repeatedly used and even after that its parts be recycled. This type of consumption namely cyclical sequence of consumption and production corresponds to economic model of communities (Rudofsky, 1964: 201)

The materials used to build green roofs, often are made of recycled resources. For example, using porous bricks and debris of building materials causes saving in the cost of building the green roof and removes or reduces the cost of garbage disposal and their transfer. Green roof provides a unique opportunity to use roofs in order to improve the economic cycle (Mahmudi et al 2006:58)

Green and Gilbertson have tested and offered three methods for improving economic conditions and lowering losses: 1) Investment to improve insulation systems (more efficient) that leads to lower humidity and greater thermal comfort 2) investment to reduce house heating costs that improves standard of living and leads to allocation of revenues to other sectors such as food, clothing, entertainment, etc. 3) Reducing household energy consumption, resulting in less reliance on fossil fuels and reduce pollution, especially air pollution (Green, 1999, 41).Enhancing the lifetime of roof membrane two or three times more with protect it against harmful UV rays and weather damage - Reducing consumption materials by increasing the lifespan of roof and reducing open repair and upgrade, energy conservation, surface water management, reducing greenhouse gas emissions particularly carbon dioxide, reducing fuel consumption all provide the grounds for reducing losses and improving economic conditions.

Comparative table of the advantages of exploiting green roof in achieving environmental aspects of energy consumption (Source: author)

Environmental Dimensions	Advantages of green roof
Maintaining Ecological Balance	Conserving biodiversity and habitat creation, improving the ecological quality, maintaining ecological cycles - sustainability
Environmental pollution control	Improving air quality (refining aerosols) - adjusting the effect of city's heat islands - the exchange of oxygen and carbon dioxide - reduce noise (sound insulation) - reducing the volume of runoff and loads of wastewater ducts systems - preventing flooding and reduction of the potential of water landing erosion - increase the quality of water and preventing its pollution - extending the operational lifetime of exploit the building insulation
Social welfare and quality of life	Reduction the cost of artificial ventilation (cooling in summer) - create air spaces and recreational - creating places for social interaction - improved quality of life - increased dynamics of the environment - Creation additional space. - create aesthetic attractions - heat Insulation
Combining development with environment	Energy saving - Improving Microclimatic conditions - reduction of pollution amount - reducing the effects of urban warming and climate change - increasing the longevity of the operation of building insulation
Efficient use of water, soil and energy resources	Saving in energy consumption - using recycle materials - reduce the consumption of fossil fuels - preventing flooding and water pollution reduction - thermal insulation

According to official statistics provided by the Ministry of Energy, energy consumption in the household sector has allocated a large share of the country's energy consumption which is about 3 to 30 percent of the country's total annual energy consumption (Sharghi, A., and Mohtashami, 2013). Providing comfort conditions in buildings and changing consumption patterns towards greater prosperity, has increased the importance of given attention to energy consumption.

3-2 Green Wall

Green wall or living wall is a wall that part of it or all of it have vegetation. Green walls depending on the circumstances may be installed indoor or outdoor. Also, there are various techniques and methods to create green walls in different sizes to form the interior space or exterior facade of buildings. Green walls are also called live walls, bio walls, vertical gardens or scientifically VCWV (Vertical Vegetated Complex Walls). Green wall is a free or standing wall that partially or completely is covered with vegetation (Li, 2010).

Green walls are very glorious; their use in green buildings creates a pleasant view that regardless of its environmental advantages, everyone can enjoy it. Irrigation systems of most green walls is composed of a frame, cells and irrigation canals. Soil acts as a conductive material in the pots.

In this system, the plant moves on the surface of the view. Plant climbing or rowing, while rooted in the ground (in an earthen bed) starts climbing the building. Recently supporting is considered for structural green facades. In this case, a simple structure as scaffolding attached to the wall, acts as a support for creeping and climbing plants such as vine and ivy.

Green facades can rely to the building facades, railings and columns and or be built as an independent structure. Green facade scaffolding structure can be from different materials such as wood, metal, mesh, cable wires and so on. So green facades are divided into two categories:

3-2.1 Traditional green facades

Traditional green facades or direct green views (that are directly attached to the wall) include climbing plants that directly and without retaining climb over the wall. Such a state is accompanied by damage to materials, attracting animals and high maintenance costs.

3-2.2 Double Skin Façade or Green Skin

Double Skin Façade or Green Skin – live wall (that is attached to the wall using a support structure) is formed with the aim of creating a green cover independent of the wall. Implementation of different types of this facades is given below:

A) Modular scaffold

The scaffolding are very lightweight steel galvanized that are on the walls of the building or have independent structure to keep climbing plants. Lattice panels that are located next to each other, can cover a large area. These panels can also be formed to build intended shapes and curves. This modular system can be bridged between different parts of the building or be used as an independent green walls, because of the hardness and strength of the panels.

B) Structural Network

Structural network is a very lightweight structures that creates a barrier of steel networks for the climbing plants that this barrier is connected to the wall or to the building structure. Wired networks are often used in holding plants that grow slowly, and need more support.

More flexible grids of cable systems and systems design capabilities are more varied. Structural networks are more flexible than cable system and have more design capabilities.

C) Cable System

Cable systems are used for maintenance of ivy branchy fast growing plants. Cable systems are formed from a set of hubs, often made of stainless steel, which provides the ability of pass of Cables and their stretch and contraction through each other to form the intended network, and is the support and carrier of the plant. Hubs via the screw which passes through the central hole of the hub are attached to the wall. Placement and the distance between the hubs on the wall will be according to the specific selected project. However the selected intervals are shaped with special attention to the plant types. Another type of cable systems that are used in green facades with wide surface, are cable – stretching facades system. These green spaces vertical systems can cover the wall of buildings such as parking or buildings which have public places or large residential space.

D) Felt Green Wall System

The visualization of this plan is to cultivate the plants on a vertical surface. This system consists of a polymer felt cloth with proper drainage that is folded in a specific form and is put on the infrastructure frame; so that one or more of pot or container be created for vertical planting as rows with upward pockets. The plant is putted in the initial pod and cultivated in this chambers. This method is newer than other systems of executing green walls and has greater benefits than the former methods. Among the advantages of this system compared to other systems are lightness of

the green wall structure, easy to replace and change plants, suitable ventilation of the plants roots, stronger drainage systems, freedom to choose different plant etc. (http://namabargnegar.ir)

3-2.3 Green wall and optimal energy management

Vegetation such as climbing ivies are a good climate tool, especially when grow on the exterior surface of the wall, in which case they will bring numerous features. Their most obvious benefit is providing shade in the summer. Dense coverage of plants during the summer acts as a buffer between the direct radiation of the sun's rays and the outer shell of the wall (Boromand, F., 1991); the only negative point in the vicinity of the outer wall of vegetation in the summer is that such a cover imprisons the air layer close to the surface of the building and therefore the wind power is reduces to remove the layers of hot air. But any wind that has enough power to pass through the leave, certainly will fix this problem and furthermore the coolness due to the vapor on the leaves also will help to cool around the building.

Effective Strategy is Expanding Urban Green Space:

Due to the high price of housing in big cities, expansion of green space in the horizontal plane is too expensive, so the main strategy of the municipalities be "expansion of green space in the vertical surfaces" (Ansari, Mohammad & Keshtkarghalati, 2006).

One of the benefits of green walls is improving energy efficiency. This type of wall increases the thermal insulation capacity by adjusting the outside temperature. The savings depends on various factors such as climate, distance to the sides of the building and the type of vegetation. This will affect both cooling and heating. This means that:

- Traps an air stack between the mass of plants.
- Limits the heat transfer through the thick mass of plants.
- Reduces the ambient temperature by providing shade and the process of releasing moisture form the surface of leaves.
- Can create a shield against the wind in cold winter months.
- In internal applications, it can reduce the consumption of necessary energy for heating and cooling of the external air for internal use.

Another benefit of using this type of wall is protection of building structures. Because the buildings are exposed to climatic fluctuations and over time, some organic constructing materials may begin to deteriorate that is caused by sequential expansion and contraction due to freezing cycle and UV radiation. The benefits of this type of wall in face with these destructive agents of the building are the followings:

- Protects the external blocks of the building against UV, particles and temperature fluctuations that cause corrosion and failure
- As the pressure increase, it is possible to help sealing around the windows and doors

Since, green walls are not just for outdoor areas and with implementation details can be used in interior spaces, are able to improve indoor air quality. For these purpose in internal projects, green walls are capable of filtering particulate of matters entering the building through traditional ventilation systems. Filtration is carried through plants and in the case of live filtration, it is performed through microorganisms. So, this type of wall have the following benefits:

- Trap the pollution and particulate matter
- Absorb deadly gases and volatile organic compounds (VOC) from the carpets, furniture and other equipment

3-2.4 The Characters of the Green Wall

Green walls are used barriers in buildings, barrier duties are as follows:

- Separation of interior spaces and exterior spaces.
- Prevention of heat transfer between spaces
- prevent the transmission of sound between spaces
- Impact resistance
- pressure resistance

- tensile resistance
- Adhesion ability of different plated (rubbing or spraying such as gypsum, cement, etc.
- Ability to install different types of coverage, such as tile, stone, fixed to the wall, etc.
- Ability of installing windows and doors

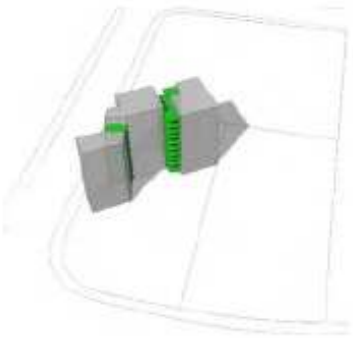


Figure 4. utilizing green space in the floors

3-3 Using green space in floors

With a careful study of the Iran architecture history we find that attention to natural elements in the construction of buildings is a principle and the respect for nature for nature has always been considered in the construction of buildings. This desire can be found in the ideologies expressed by the famous architect like Le Corbusier and Wright about satellite cities that all of these content are the effect of today's human needs on design pattern on a large (urban) scale.

In the design of private open and semi-open spaces and with control capability, a space is created that as a dynamic element in the wall façade has a helpful operation in summer and winter and provides additional space in vicinity of the residual areas. This space can be used as a terrace or garden.

CONCLUSION

The effect of sunlight in the architecture is undeniable according to the context of cities formation. Temperature in urban areas is increasing due to the replacement of natural vegetation with flooring, buildings and other structures that are necessary to place the growing population. In this phenomenon that is known as heat island effect, the energy of sunlight is converted to heat. Therefore using plants in urban environments, buildings and environments around them are cooled, provide shadow, reduce the reflective heat and produce humidity. The benefits of plants in this regard are as follows:

- Enhances the natural cooling process.
- Reduces the ambient temperature in the building.
- Breaks the vertical air flow and then while it slows down, cools it.
- Shades over the usable surfaces and spaces in the building.

Temperature rise in modern urban environments, along with the increasing number of cars, air conditionings and industrial pollutions results in increase of the amount of nitrogen oxides, sulfur oxides, volatile organic compounds (VOC), carbon monoxide, and particulate matters. The benefits of using plants to improve air quality in the buildings is as follows:

- Traps the pollution in the air and atmospheric particulate matter on the surface of leaves.
- filters out deadly gases and minute particles

What is today under consideration more than any other crises in development plans especially sustainable development, is the energy consumption management. In architecture of city and the places of human life the subject of optimal energy consumptions is of high importance. So one of the solutions is using active and passive methods in the energy consumption management. Some of these methods include the use of green space in the structure and architecture of buildings that in consequent to its natural features is effective in temperature reduction and reduction of surface evaporation. Different methods of using this live and green spaces in green architecture is considered and examined. Among the variety of operational strategies the following can be mentioned:

Green roofs, green walls –the use of live walls – using green spaces in floors and balconies or internal spaces.

All these factors can result in pollution reduction, temperature reduction and increase of humidity and eventually more closeness of building spacing to comfort situation and energy consumption reduction to compensate the temperature and humidity and refining internal air make using green spade usual and recommend it.

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