

Nature up High Apartment (Green Roof)

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ABSTRACT: Nowadays cities benefit from two geographical (natural, social, and economical environments) and artificial (man-made environment, and architecture) symbols. Mankind has always been trying to change these two symbols for the sake of his daily activities or earning his life and establishing a dwelling both as an interest and as a shelter. During this process green areas, jungles, and gardens have been changed into skyscrapers and buildings. Bricks, cement, and metallic plates have replaced for attractive views of nature. Today's citizens have a sad feeling while they see that they have fallen far from the beauties and quietness of nature. To solve this problem, industrialists have developed the green roof technology. Urban planners and architects use it as a 'back to nature' process. Green roof is a method to convert the rough, dry, and cold parts of the city into green spots. Besides green roofs can create micro-climatic zones which reduce pollution and improve the living conditions of the citizens. Green roof is the subject whose Iranians were acquainted with it since long to now but necessity of it doesn't consider by responsible comparatively. Clarification and expanding of this issue has been explained in this paper. In addition, using some of benefits and condition of performance of the layers of green roof, it has been tried to utilize the green roof in the future more as much as its popularity in that past. To be considering of the architecture in making a city, this necessity gets more highlight if green roof systems get installed on the roofs of the buildings of a city, it will be important effect in all architecture sides of that city and it too high extent decreases architecture limitations. This process is highly advantageous for cities like Tehran which is located in a 730 sq. km of land delimited by mountains and deserts. 67.9 percent of the city is occupied by buildings and about thirteen million people live in this city. Green roofs are good means for reducing these problems of Tehran.

Keywords: Green Roof, Roof Garden, Drain, Artificial Filter, Damp-Proof Coarse

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INTRODUCTION

Flower- beds idea on roof and plantation on it is employed by Iranians in 2500 years ago and 600 years BC {before the birth of Christ} by BABEL people in BABEL hanging gardens. Green spaces development had more growth in cities and roofs in the last fifty years and it took more increasing speed to self in fifteen years ago in Europe and America. Aim of the exhibition of this paper is reminder and introduction of the green roof or same roof garden that nowadays, it forgotten for Iran's people to can take a fixed step side more stability of the country life environment and establishment of the more healthy and pure space than yesterday.

With due attention to green space share shortage in the cities and problems existence for establishment of it, such as more high cost of this order, lands expensiveness in the huge cities and to consider this problem which can give persuasion and partnership citizens in cities vegetable coat deployment, people for partake in grow, knowledge necessity is inevitable enjoyment of the surface like roof which since was almost unusable place.

In word, with be environment roof garden, it can decrease to self-share from problem that creates for our future generations and children of this country to provide healthy, moral and pure bed for them.

In same direction, this paper pays to introduction of the roof garden (green roof) and inform one by one of

citizens to importance of this subject to be environment roof garden in cities someday.



Figure 1. Green Roofs: The Urban Jungle's Upper Canopy

This problem will be no certainty unless we have revisions in work, designing and executive methods and instead of use imported and expensive revisions in work, designing and executive methods and instead of use imported and expensive materials can find an opportunity to this important of existence materials in country and to

consider production capacity of all of them into country with costs decrease and quality increase that this problem will be consider to comment below.

The Green Roof Definition

A green roof is a kind of roof covered entirely or partly by soil and plants or growing vegetative environment. The term green roof is sometimes used to associate the roofs with green architectural aspects such as solar or photovoltaic panels. Actually, a green roof is a roof with plants growing on its surface. The plant diversity of such a structure can range from artificial grass coverage to a roof garden covered with plants used for perspective design (www.NationalGeographic.com). Making the roof green requires types of plants which are able to resist against the hostile and soulless environment of the roof under various conditions like dehydration, freezing, storm and etc. types of selected plants varies depending on the climate and regional conditions.

The implementation details of green roofs are not so different from that of normal roofs and consists of heat/moisture insulator, waterproof layer, sand, and sealant. The green roof projects require materials and elements which can provide the maintenance, water canalizing, and protection of plants according to the defined standards. Another technology is creating the green facade which has less structural limitation comparing to the green roofs, however, less plant diversity (www.GreenAmerica.org).

The green roof has a significant role in rain water managements, water recycling, greenhouse gas effects reduction, diversity of urban living creatures (plants and animals), protecting the Earth's crust, preventing the UV radiation to buildings, air refreshment, temperature reduction, milding the hot weather, avoiding the firing in buildings, reducing the electromagnetic radiation, enhancing the regional quality and creating sort of air conditioning in cities, energy saving, reducing the noise pollution, reducing the costs of the roof maintenance and adjustments, creating calm environments in city congested areas and developing new recreational zones, enhancing the food safety of the city and also as a laboratory for various research and educational activities (Zahrabi, 2006).

The Construction of Green Roofs

The construction of roof gardens requires its specific knowledge and planning. The green roofs need a kind of technology beyond the normal roof engineering in terms of maintaining the capacity and controlling the load of soil, rain and snow and designing the walking paths. A green roof is consisted of three sections:

1. The building's ceiling or anything like that on the roof of any building and upon which there is an insulator layer like tar layer and upon that there may be mosaic or asphalt or paving.

2. Roof garden which is protective coating and separates the ceiling and waterproof insulator from the soil and plants layer.

3. Soil, fertilizer, and watering system each is placed accurately in its own position (www.GreenRoof.ir).

The material used in the construction of roof garden benefit from high durability which means no need

for periodical replacement. Their sustainability ranges between 30 to 50 years. Generally, the equipment manufacturers consider two main bench scale for these roofs: intensive roofs and extensive ones. Application of each scale depends on defining the use of the roof garden, the plant diversity and the costs of its construction and maintenance. The systems designed for green roof are light, needing low maintenance and durable. The applied material absorb the rain water and decrease the risk of overflow by reducing the velocity of current water during sudden heavy rains. The modern watering approaches of roof gardens, minimize the water consumption and keep the existing moisture of the soil and avoid from rapid evaporation. During construction, initially waterproof insulator layer and then proper canalizing network is installed on the roof. Creation a proper growth medium is necessary for a good green roof. Unlike the normal soil, this kind of medium is designed corresponding to the environment and doesn't get so heavy when soaked. Finally the plants are implanted. The kind plant coverage used is resistant against hot and cold. These vegetations include perennial gramineous plants, flowers, wild grass, and moss (Bianchini et al., 2012).



Figure 2. Extensive System



Figure 3. Planter Box System

In recent 15 years due to the discovery of new combinational material and facilitation of construction phases of roof gardens, this kind of construction has

become so lucrative. With the rapid development of technology and production of new material it is possible to construct a nice garden with different plants on the roof of any house, apartment, organization, school, hospital, and other buildings and benefit from sun-exposed and unused space of the roof with a low cost. These gardens can be used by the residents at any time of the day or night. Considering the fact that creation of green spaces in cities is expensive due to the lack of land and high prices and most of lands are occupied by the buildings and streets, it is possible to bring back the lost pure nature of the cities by changing the roofs into gardens. Meanwhile, the construction of roof garden is an effective and cheap solution to reduce the environmental pollutions. According to an investigation, each square meter of green space can get and refine about 0.5 kg of the air pollution annually (www.GreenRoof.ir).



Figure 4. Intensive System

Types of Green Roofs

Green roofs or roof gardens are categorized into three main groups based on executive system, depending on the average implantation depth and required facilities:

1. Extensive System
2. Intensive System
3. Planter Box System

Extensive System

- The term Green Roof is used for this system.
- This system is also known as low section or thin application.
- This kind of roof is only consisted of one or two types of plants and shallow implanting medium.
- This system is usually used when the minimum load is applied.
- Specifically, only the maintenance attendants have access to this roof.
- Just as Norwegian grass, this system is applied on flat or sloped roofs.
- Plants with root depth of 40 to 100 mm are used in this system.
- The approximate maximum load of this roof is between 50 to 100 kg over square meter.
- It is recommended to apply this system on the roof with the gradient of 10 to 20% in the case of shelvy roofs. In the case of 30% gradient, it requires to use sealant and anti-erosion equipment.

- It has a shallow and surface implanting medium which is usually a part of the roof or the green building structure.
- An extensive green roof is generally available for public and is not used for specific applications (Zhang Xiaoling et al., 2012).

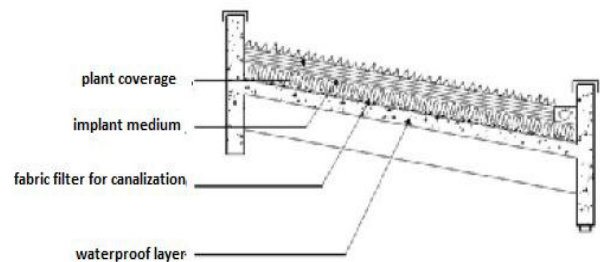


Figure 5. Implementation Detail of Extensive System

- Mountain Equipment corporation's building roof (the picture below) is an example of an extensive green roof which has been constructed in 1998.



Figure 6. Mountain Equipment Corporation's Building Roof (An Example of An Extensive Green Roof)

Intensive System

- The term Roof Garden is used for this system.
- This system is also known as "deep section" or *Roof Garden*.
- The roofs used in this system require certain depth of soil for growing of the massive plants and grass.
- This kind of green roof include various types of plants and is designed similar to a park.
- Some of the green roofs have big trees and fountains. In this case, especially for the roofs with public access, the need for structural reinforcement is inevitable.
- These kinds of roofs require watering, fertilizing, and other maintenances.

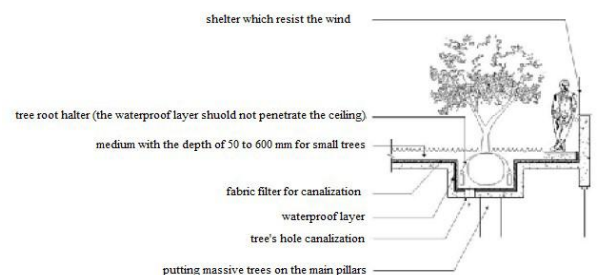


Figure 7. Implementation Details of an Intensive System



Figure 8. An Example of an Intensive Green Roof

Modular System or Planter Box

- In this system, plants are implanted and kept in special boxes covering the whole or most parts of the roof.
- In non-modular systems the medium is in the form of a contiguous layer on the green roof. However, in modular system this medium is not contiguous.

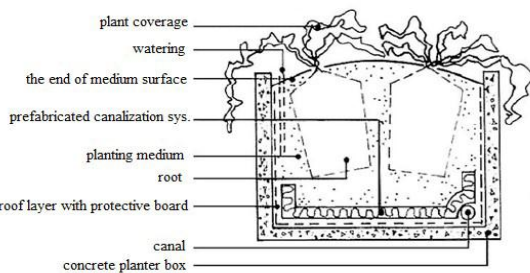


Figure 9. Implementation Details of Modular System or Planter Box



Figure 10. Modular System or Planter Box

Another categorization approach is classifying the roofs into flat and gradient. Gradient green roofs are the outstanding characteristic of many Scandinavian buildings

which require simpler design comparing to the flat roofs. Because the roof gradient reduces the risk of water infiltration, using fewer waterproof layers and canalizations comparing to flat roofs.

Green Roof Layers

1. Structure Roof

The roof layer lowest is the roof.

2. Damp-Proof Coarse

Layer which acts on roof, it must be insulator and resistant opposite moisture and it must be prevent water settlement to roof and life of it must be long too.

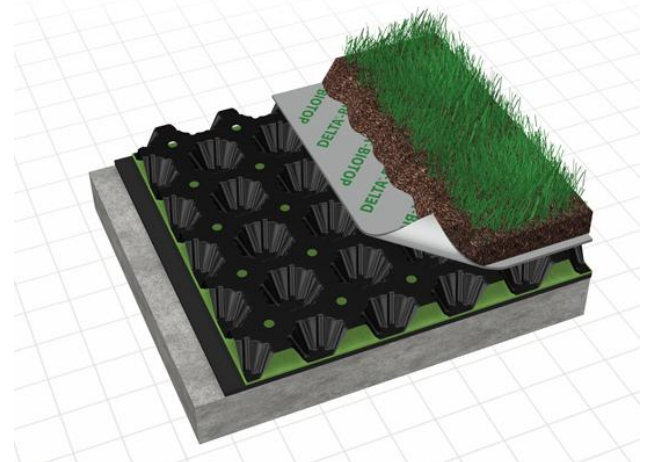


Figure 11. Water Retention and Drainage for Garden Roof Applications

3. Drain

This layer settles between plantation environment and humidity protection layer till water can take place of every green roof place to building drain system. Suitable drain layer selection performs based on water flow maximum which determine from the precipitation information since drain layer supports plant plantation environment, compressive strength of it must be suitable. Some of systems act easily heavy and thick layer of expanded soil and clinker but now they use wavy plastic mat with similar structural pattern to egg carton, minimum drain layer thickness is 20 mm but thicker plastic mat can be lighter and an redundant insulator which pass water too, it prevents roots putrefy, it can save water too till soil stays moisture and it decrease keeping period and times of it (Luckett, 2009).

4. Filter (Purity)

This layer to simple language prevents soil passing and infiltration in it is simple for reach in drain. For this reason, Synthetic fibres such as PLM and geotextile are suitable and light and it suggest don't use aggregate materials in this cases (Luckett, 2009).

5. Soil

With due attention to amount of structure bearing must study soil special weight, kind of it and be nutritive of it till structure tolerates power of it too and has not need to fertilizer continuous nourishing too. Soil depth with due attention to kind of plant and mentioned factors determined that it is surface (to 10 cm) or deep (more than 10 cm) (Pilaskoelek et al., 2008).

6. Vegetable Covering (Coat)

Plants select with due attention to numerous factors as:

• Plants With Need To Low Water

Resistance opposite dryness is one of plants selection important factors. Plants resist by deep roots, pin, are fleshy of stem and leaf opposite dryness. By plantation of this species of plants economize in other costs like keeping, situation of a worker force and lot amount of water (Pillaskoelek et al., 2008).

• Plants With Lot Life Long And Are Four Seasons Of Them

Plantation cost has direct relation with survival of vegetable species. Shopping and plantation of expensive species that which has lot survival rate, is low prior rather than cheap species plantation with survival possible (Pillaskoelek et al., 2008).

• Agreeable And Of Little Expectation Plants

From economic viewpoint whatever plants be more agreeable with environment, it has less keeping cost. Of course, this only isn't meant that of little expectation plants, meek and low cost be sow to every form which are, but costs with special aim must decrease from green space establishment that there is (Luckett, 2009).

• Vegetable Spices Need To Little Cropping And Forming

• Plants With Surface Roots And Avoidance Of Sharp Root Plants

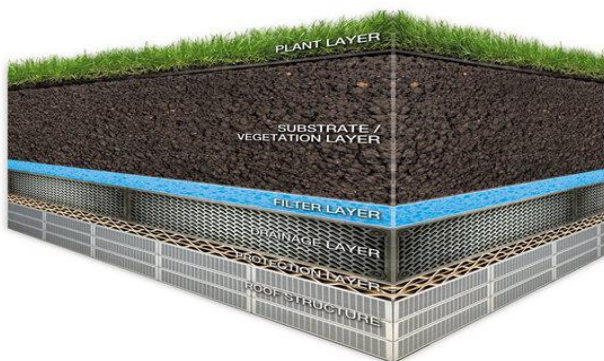


Figure 12. Layers of a Green Roof

Share determination of the green space in country is been with due attention to other countries standards and it depends on bioclimatic condition that is statement of various cities climate condition difference. With due attention to this that green space share in Iran's cities is 7 to 12 square meters for every person, this is in case whose universal standard of green space share for every person is 20 to 25 square meters in the world and for increase of it usually use taking possession on expensive land which has expensive cost and same order leads to slowness of the development. Of course that these costs can carry in side of development laws collection, green roof deployment and advertisement of it or spend in loans given along it by government (Sebghati, 1992).

In this manner can paint green Iran by engineering companies performing to this aim and use of country existence capacity without need to expensive costs and by citizens partnership can reach to this importance and increase green space share for every person. Last pollutions in country with due attention to sites statistic of life environment organization and weather organization of total country in case of warning in November, December and January, since pollutions settled in cities such as ,Tehran, Isfahan, Tabriz, Shiraz and this self-reveals necessity of green space expansion for environment condition stability.

Irrigation of Green Roofs

The water of green roofs is provided by two sources:

1. Artificial Irrigation: It is used two methods in artificial irrigation as following: Manual method and automatic method.

Automatic method is conducted in forms of Analog and Digital which might be one-station and multiple-station. In both methods, adequate moisture will be provided for soil and roots.

2. Natural Irrigation (Rain Water): In this case, the extra water of soil humidity is stored through purifying layers of water and drain layer and make it rich from further irrigation up to somewhat a long period of time.

On the other hand, if extra water yields on an anti-moisture layer, it is transferred to the outside by slope of the roof. The extra rain water can be stored in the storages after the purifying. (For instance, like the flash tank toilet systems) isolated layer of roof made by compact Polypropylene prevent moisture penetration to the roof (Weiler et al., 2009).

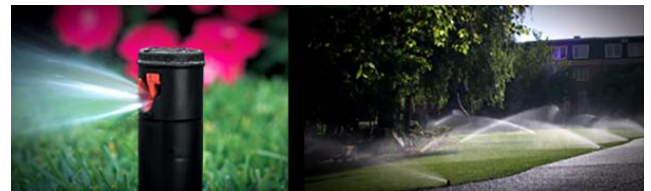


Figure 13. One Example of Performing Automatic Irrigation

Some of the available plants which are used on green roofs

- Actinidia
- Trifoliata
- Aristolochia
- Compsis
- Celastrus
- Clematis
- Cotoneaster
- Fortuhynia
- Hedra
- Homulus
- Lonicera
- Parthenocissus
- Vitisberlandieri
- Polygonum Auberti
- Pyracantha
- Wisteria

Green Roof Advantages

1. Gas Pollutions Attraction and Dust Particles:

Of course, plants attract CO₂ of the air in day and they product oxygen and this topic acts vice versa in the night, it is mentionable that air temperature is usually less in the night and plant receives less oxygen but in the day that air temperature is warmer, it gives up amount of considerable oxygen.

Roof garden acts similar to a refinery for city air so that a square meter of grass didn't picked on building flat roof in the city is capable attract air dust and half kilogram of the pollution during one year (Tabrizi, 2008).

2. Civil Temperature Decrease: Nowadays, cities because existence of industries, cars and ever-increasing enhancement of them meet to warm up problems which is one of the most important factors opposite this warm up of green space establishment that it attracts heat by performance of photosynthesis action and causes to cool city air. So that even in country northern cities in spite of suitable vegetable coat can observe shortage of it in the cities (Sebghati, 1992).

3. Economy In The Energy Consumption

• Need Decrease Too Cold In The Summer

Existence of roof garden causes which environment heart decreases and moreover green roof layers cause less heart leak into building or have cooler air.

• Need Decrease To Heart In The Winter

Also green roof acts like insulator in winter which prevents building heart exit.

4. Sound Insulation

Roof garden and layer establishment of solid cause be kind of sound insulation in ceiling, plants in spite of leaves attract waves to self and they will be lead to sound pollution decrease.

5. Rainwater Control, Flood And Savings Of It

By increasing of soil surface in cities can raise amount of water attraction by soil in the rain and prevent flood too. Drain layer designed in roof garden so that has amount of the water detention power in self to keep moist soil for a while and this order caused rainwater savings, prevent flood creating and use rainwater as optimum (Weiler et al., 2009).

6. Nature And Man Again Union

In time whose civic communities machinery life is repeated its every day and man view in life environment is building and machine, everything which can exit man life of this repeats closed circle, it deserves attention, hence man need to again return to nature or in word, near nature to self so that sometimes it needs to happy and joy of it, it has used power of self-roof for this aim and it experiences happy morale and new quiet (www.NationalGeographic.com).

7. System Establishment For Prevention Of Heat Island Phenomenon

Heat island consists of places in cities surface or generally all of city which warmed up rather than environs

of it and sometimes this difference arrives to 10 centigrade degrees and accounts serious danger for residents, in spite of green space can prevent to more extent of this importance (Weiler et al., 2009).

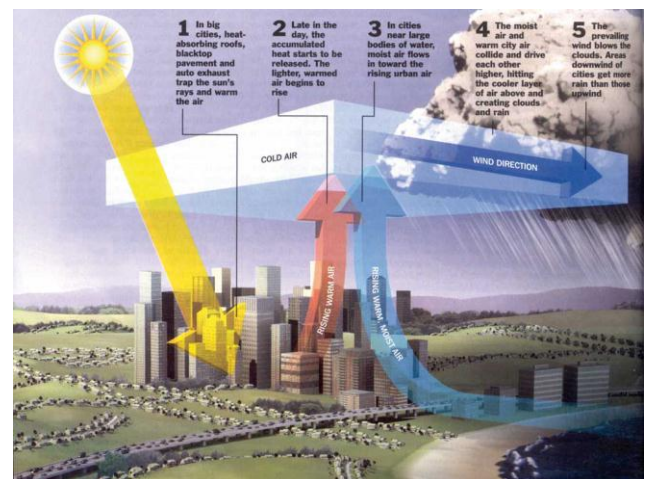


Figure 14. The Urban Heat Island Effect

●The Urban Heat Island Effect

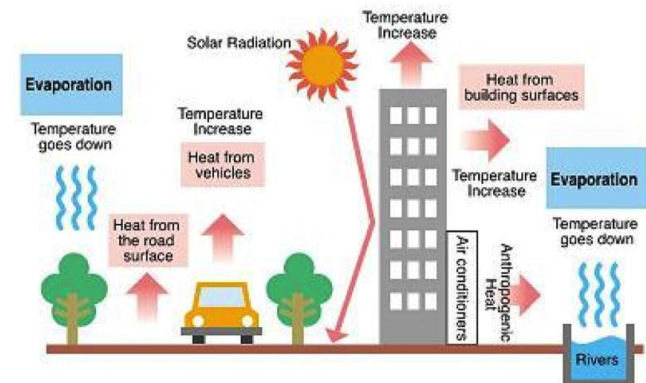


Figure 15. Energy Balance in Cities That Contributes To Urban Heat Island Effect

8. Environment For Kind's Cultivation Of The Plants, Fruits, Vegetables And Flower

9. As Heavy Mental Reducing Act Companion Precipitation Runoff

10. Life Length Increase Of Roof Insulator Main Layer And Be Removed Of It Of Atmosphere Operations

11. Life Variety Increase, Place For Different Plants And Animals Growth In The Cities Surface

Green Roof Faults

1. Need To Existence Structures Reinforcement
2. In Some Of The Cases, Design Comparing Of These Roofs Is Hard With Climate Condition Of Work Area
3. Green Roofs Also Need Acceptable Structural Criteria That Numerousness Of Existence Roofs Because Of Soil Necessities And Plants Weight Bar Aren't Suitable For Having Green Roof (Weiler et al., 2009).



Figure 16. California Academy of Sciences (Architect: Renzo Piano): The Total Prospective Of the Complex

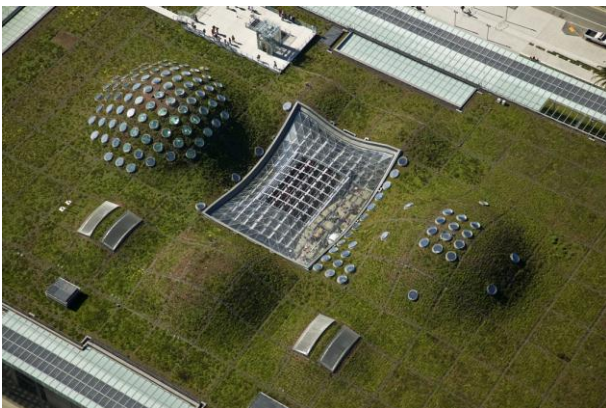


Figure 17. California Academy of Sciences (Architect: Renzo Piano): The Shot of the Roof

Cost of Construction of Green Roof

A green roof which is technically designed and performed cost between 5\$ to 35\$ per feet square in average regarding to the nature of area, type of building and building system, and type of plants which are grown. This cost, in comparison with mentioned advantages, not only has an investigating value, but also, its social-economic effects on people lifestyle make its performance economical (Bianchini et al., 2012).

CONCLUSION

1. With due attention to mentioned cases along prevention of last pollutions, optimization of energy consumption, environment condition stability and less use of mortal sources or even again production of them state necessity of this problem whose green roof must discuss by new rules composition as a necessity and important need of human.

2. By native materials or internal new productions can consider costs decrease that this is more important side was environment of green roof side green space share increasing in country and remove of this problem.

3. Accomplishment of this design lead to governmental costs decrease and participation and persuasion of the people in green roof expansion must program by government and must provide facilities till all participate in this order.

4. Whatever nature for people, who live in the near of jungles, it isn't foreign but problems in cities kept far

them of the nature and green roof causes nature return in several steps of the man.

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