

# Research7

## Roof gardens in Egypt: fact or architectural fiction

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**Henar. Aboelmaged. Kalefa**

**Assistant professor of Architectural engineering, October 6  
University**

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• المؤتمر والمعرض الدولي مستقبل المجتمعات العمرانية الخاصة ( نحو تنمية عمرانية مستدامة )  
وزارة الإسكان والمجتمعات العمرانية المركز القومي لبحوث الإسكان والبناء
- 2 • **The impact of integration of new technology insulation material phase change material (PCM) as insulation material on thermal comfort in residential buildings compared to traditional material**  
• Faculty of Helwan– Mataria Engineering Research Journal
- 3 • **Sustainability of university buildings through building standards (LEED) and how to be achieved.**  
• International Journal of Current Engineering and Technology.
- 4 • **استدامه المباني الذكية دور تطبيقات مبادئ الاستدامه للوصول الى التوازن بين التكنولوجيا والبيئه**  
• Journal of AL Azhar University Engineering Sector
- 5 • **The Role of Sustainable Maintenance to Ensure Sustainability of the Urban Spaces Heritage.**  
• Journal of Engineering and Applied Science Faculty of Engineering ,Cairo University.
- 6 • **الصيانة وإعادة استخدام المباني التراثية في القاهرة التاريخية**  
• Journal of AL Azhar University Engineering Sector
- 7 • **Roof gardens in Egypt: fact or architectural fiction**  
• International Journal of Current Engineering and Technology
- 8 • **Ancient Egyptian Design to Achieve its Function With Different Factors.**  
• Engineering and Scientific Research Journal Faculty of Eng. Shoubra

## Research 7

**Roof gardens in Egypt: fact or architectural fiction**  
**International Journal of Current Engineering and**  
**Technology**  
**Vol-8-No-4-July-Aug-2018**

بحث فردى

## Roof gardens in Egypt: fact or architectural fiction

### *Abstract*

*Planting gardens on rooftops have become one of the great projects being carried out in many countries; due to its positive effect on reducing the temperature, reducing carbon emissions, improving the internal environment and, thus, improving the health of the society.*

*With the increase of buildings, the lack of green areas and the negative effects of the environment, we started looking for ways through which it is possible to find architectural solutions compatible with the natural environment through an environmental and economic balance, in addition to providing an entry point contributing to creating green areas amid the crowded populations. Hence, this gives rise to the idea of research by taking advantage of the roofs of residential buildings. Thus, this research has focused on the concepts of green roofs, types roof gardens, and then conducting an analytical study of a number of the global and local green roofs experiments and clarifying their ideas and design principles to find the pros and cons of applying the roof gardens idea in Egypt. In line with the environmental, economic and social conditions in Egypt.*

*Keywords: Green roofs – Planting rooftops - Environmental impact – Roofs arranging - ecological gardens.*

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## Research Article

## Roof gardens in Egypt: fact or architectural fiction

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## Abstract

Planting gardens on rooftops have become one of the great projects being carried out in many countries; due to its positive effect on reducing the temperature, reducing carbon emissions, improving the internal environment and, thus, improving the health of the society.

With the increase of buildings, the lack of green areas and the negative effects of the environment, we started looking for ways through which it is possible to find architectural solutions compatible with the natural environment through an environmental and economic balance, in addition to providing an entry point contributing to creating green areas amid the crowded populations. Hence, this gives rise to the idea of research by taking advantage of the roofs of residential buildings. Thus, this research has focused on the concepts of green roofs, types roof gardens, and then conducting an analytical study of a number of the global and local green roofs experiments and clarifying their ideas and design principles to find the pros and cons of applying the roof gardens idea in Egypt. In line with the environmental, economic and social conditions in Egypt.

**Keywords:** Green roofs – Planting rooftops - Environmental impact – Roofs arranging - ecological gardens.

## 1. Introduction

We started, in ancient times, to think of the green buildings. These buildings are proverbial and have many wonders such as the Hanging Gardens of Babylon (Diodore, 1947).

, where the architect think of it since ancient times, but he did not suffer from the problems we are experiencing now, such as Global Warming, pollution, the high price of land for construction, population growth and the lack of green areas.

By looking at the roofs of a residential area in Egypt, we sometimes find a water tank Fig.1. , a nest for breeding birds or a storehouse of old things. Therefore, adopting the concept of green architecture, as one of the modern trends in



Fig.1. roofs of a residential area in Egypt(author)

architectural vision, has become necessary to be applied in residential areas through planting the rooftops; this would compensate for the shortage of

urban green areas in towns due to the increased buildings. When the architect adopts this idea, he does not care only about beauty, but he seeks to solve many problems by taking advantage of all empty spaces prepared for construction. The green roofs offer several environmental benefits, the most important of which are the thermal insulation of the building, heating it during the winter and cooling it during the summer, thereby reducing the energy consumption. It also contributes to absorb the rainwater, provide a life-friendly environment, give a special character to the city leading to enhance its aesthetic value, in addition to investing the rooftops of the buildings by planting vegetables or medicinal plants in it.

## 2. Green Roofs through the history:

Although the green roofs seem to be modern, they have historical roots that extend to the Babylonian civilization in Iraq on the banks of the Tigris and Euphrates Rivers, which are mentioned in many historical books(Maroun,1976).



Fig.2.Hanging Gardens of Babylon  
(<http://mawdoo3.com/%>

The Hanging Gardens of Babylon Fig.2., also known as the Hanging Gardens of Semiramis which considered as a huge palace planted with plants, trees, and flowers of all kinds, we can inspire from it the idea of green areas. In these gardens (k. Matviev, and A. Saz Nof, 1991). There are all kinds of trees, vegetables, fruits and flowers which remain fruitful throughout the year; because of planting the summer and winter trees. The Hanging Gardens of Babylon is a unique architectural masterpiece with a geometric layout in architecture and advanced irrigation engineering (Diodore, 1947).

At the beginning of the 20th century, the Kremlin Palace, located at the Russian capital "Moscow", is considered as one of the oldest gardens planted on rooftops in the world. Similarly, there is the Hermitage Museum garden, located at the Russian city of Peter Burg. Thanks to the architect "Le Corbusier", and the other architects, it became possible to construct a building with flat roofs, thus, planting the gardens on these roofs. In 1912, Suvaigio built a house with green terraces in Paris. In 1913, the Italian architect "Antonio Saint Elia" has constructed a terraced building with gardens. In 1923, the architect "Adolf Loos" was built a hierarchical building in Paris with green terraces. Moreover, the two Italian architects "Marcotti" and "Deutolivi" were prepared a project for constructing gardens hanging on the facade of a residential building upon a Chess system. In 1932, the architect "Le Corbusier", has constructed in Algeria a graded building with wide green terraces (Maha, 2016).

The rooftop of Rockefeller Center in Manhattan, which has been developed as a decoration Fig. 3., is one of the oldest green roofs in America since 1939, as part of a project aimed at workers. The green roofs appeared in Germany that about 10% of all the roofs of German cultivated. At present, a number of active associations in European countries are promoting the creation of green roofs, including the cities of Switzerland, Bulgaria, Sweden, the United Kingdom and Greece; but this process is relatively slow, despite policies adopted to encourage the use of green roofs (Ali, 2013). The green roofs became an architectural trend applied in many countries of the world Fig.4. , whatever its purpose: aesthetic, economic or urban (Sidonie, 2014).



Fig. 3. The rooftop of Rockefeller Center in Manhattan

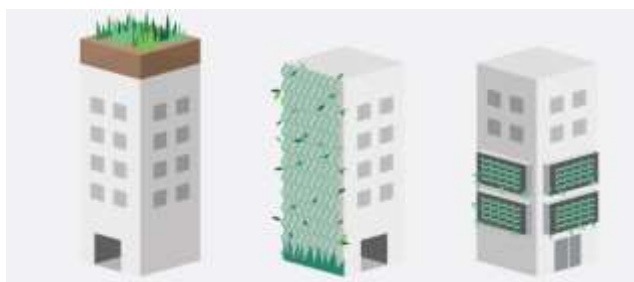


Fig. 4. Vegetation can be added to a building as a green roof, green wall or green facade (Sidonie, 2014).

### 3. Concepts of green roofs:

Green roofs are the buildings roofs covered, totally or partially, by some plants cultivated on a waterproofing layer and may include additional layers such as root-resistant layer

and drainage & irrigation ones (Farid 2015).

. A green roof (also known as an eco-roof, planted roof, nature roof, living roof or roof greening system) is a living, vegetative system that contains a substrate (growing media) and a vegetation layer at its outermost surface (Serpil, 2014).

Green roofs have several definitions: That's means that a building roof is, totally or partially, covered by plants. (Leigh, Bradley, 2012)

it is considered as an ecosystem that makes the urban environment livable, sustainable and efficient.

Green roofs are considered as roofs planted on the roof structure to help reduce heat. (Eleftheria, Phil, 2008). purify the atmosphere against pollution and reduce heat (Al Bustani, 2002).

The researcher defines it as "Planting a building or designing a building roof under construction with plants of all kinds: food plants, medicinal plants or ornamental trees

### 4. Types of green surfaces.

There are many types of green areas, classified as follows:



#### 4.1 Depth of the soil and types of plantations used, including:

##### 4.1.1 Extensive Roofs:

These roofs are considered as flat or slanted ones with 30 degrees, cultivable and suitable for industrial buildings, commercial centers, offices, administrative buildings, and hospitals.

##### 4.1.2 Intensive Roofs:

These roofs are considered as roofs gardens and constitute one of the modern urban landscapes. They are designed and arranged as real gardens planted on the ground and used as general or semi-general spaces. They require a soil with a thick of 30-35 cm. Construction of building has an impact on how to arrange the garden. It is possible to plant the long trees on the concrete columns of the building to make a beautiful panoramic view (Maha,2016).

Shrubs and floral be used in arranging the evergreen species simple architectural toys, hammocks, can also converted into a green sized tiles in regular or tiles with stone and water lakes can also be plants made of natural or



Fig. 5. Shrubs and floral ornamental (http://www.harvestpower.com/greenroof).

##### 4.1.3 Semi-Intensive

These roofs are extensive and intensive workers. It includes 20 cm Fig.6. It can be various kinds.

##### 4.1.4 Biodiverse Roofs

It is similar, in structure, designed to create a plants.

There is another classification of green roofs types, as follows:

##### 4.2 According to the

**4.2.1 Intensive roofs:** It has a soil thickness of 15 cm. This depth contributes to the growth of large plants such as trees and shrubs. This large soil thickness and the type of cultivated plants represents an excessive load on the building. Therefore, it requires programs for maintenance and scheduling irrigation and feeding, but this makes the roof more expensive.

**4.2.2 Semi-intensive roofs:** This type provides a diverse view because it includes shrubs and wildflowers and is characterized by the relatively low cost, requiring a limited maintenance and irrigation schedule. This type is considered as a mix between the aesthetic, ecological and recreational benefits. It is the system applied in Egypt.

**4.2.3 Non-intensive roofs:** In this type, Herbs and small-sized plants are planted. It does not require much maintenance but only needs to be cultivated and fertilization, with low cost[8. (Al Bustani, 2002).

In our view, choosing the type of green roof, if applied to an existing urban neighborhood or creating a new one, achieves the idea of green roofs or roof gardens; this requires cooperation between the architect, the contractor and the agricultural engineer (specialized in gardens) in order to produce a project with few problems.



ornamental plants, suitable for climate Fig. 5, can these gardens, taking into consideration planting that remains throughout the year. Moreover, forms, such as umbrellas, pergolas, children's be developed depending on the roof area to be one. The corridors can be covered with small-irregular shapes, with the possibility of mixing bricks in the form of lines and drawings. Small built with a depth of 20-30 cm, and bowls of artificial stone can be provided.

##### Roofs

considered as a medium roof between the roofs. It can be reached by maintenance paved areas and corridors, with a depth of 10- planted with shrubs and ornamental plants of

to the intensive roofs but is specifically wildlife habitat and can be cultivated with local

Fig.7. green roofs consist of a group of layers (https://www.lid-stormwater.net)

##### intensity

intensity

#### 5. Components of green roofs:

The green roofs consist of a group of layers, as follows Fig.7.:

5.1 The plant's layer: the plant's type varies depending on the type of green roof and the climate; the extensive roofs

uses low-growth plants such as a type of flowers or other types resistant to frost and drought. For the biodiverse roofs, it typically uses the plant types such as wildflowers, shrubs, and durable herbal plants. For the intensive roofs, it can include a wide range of agriculture such as shrubs, meadows, and trees.

**5.2 Soil layer:** It consists of a mixture specially designed by measured rates of organic and inorganic materials to feed soil green roofs for root growth, while providing air, water and food at required levels and with the same period, to facilitate draining the water.

**5.3. Filtration mat:** It is considered as a woven or non-woven tissue that prevents the leakage of sediment into the drainage layer (Sheffield and Green Roof Center, 2011).

**5.4. Drainage network:** It is a variety of materials such as hard plastic, polystyrene, and foam. The coarse gravel and bricks can be used depending on the functional requirements. So that the drainage layer is operated properly, It must allow draining the excess water, not to move the soil layer with water and retain additional water that can be discharged to the soil layer during long dry periods.

**5.5. Plant root barriers:** It is the membrane that permanently protects the water-insulating layer and prevents plant roots from growing. It can take the form of a separate membrane or be the insulation layer and may be either a chemical or a physical barrier.

**5.6. Insulating membrane:** It is a layer that protects the roof with several thicknesses, ranging from 2-12 mm to protect the roof from water leakage.

## 6. Importance of green roofs:

The importance of green roofs is based on some levels, as follows:

### 6.1 At the ecological level:

Using the green roofs reduces the challenges of modern cities; as it protects the traditional building roof. Moreover, The use of green roofs leads, on a large scale, to reduce some civil problem, for the following reasons:

- The green roofs have a positive effect on air quality, reduce air pollution and reduce carbon pollution.
- The green roofs help to cool and purify the air, produce oxygen, regulate humidity degree and absorb dust.
- The green roofs can reduce the amount of energy needed to temper the heat inside the building and, thus, reduce the energy consumption; as it acts as a thermal insulator.
- The green roofs reduce the rainwater runoff in the streets and dispose of its contaminants.
- The green roofs absorb the rainwater; because it acts as a water absorbent sponge; where the water is stored and then returned to the atmosphere through evaporation.

The green roof, with an average thickness of 5-20 cm, can retain about 100-150 mm of water. The time required to drain the water on the green roof is greater than the water drainage on the normal roof (<http://www.maddyyoung.com/10325>).

The green roof contributes to improve the internal environment and air inside the house or the building and increase the lifetime of the buildings, which will positively effect on the health of the community and preserve the "ecosystem" (Arid Land Research Center, 2010).

This system also has a direct environmental, aesthetic and economic impact on the city; as it requires a less heating in the winter and less cooling in the summer than normal-roofed buildings. A study in Canada showed that the use of green roofs reduces the energy consumption by 26% during the summer and reduces the heat loss with the same percentage mentioned above during the winter. Adding a layer of soil and plants to the roof increases the thermal insulation layer on the roof; as the roofs are the most

places to lose internal heat in winter and make the building more hot in summer (Erica, et al., 2007)

The green roofs also act as a natural acoustic insulator; as it helps to reduce the noise in the spaces under these roofs. The research has found that a green roof, with a thickness of 12 cm, reduces the noise by 40 dB and another one, with a thickness of 20 cm, reduces the noise by 46-50 dB (Sheffield and Green Roof Center, 2011).

Also, it gives the opportunity to relax when looking at the splendor of green color and enjoying the beauty of plants and plantations that bring peace and calm.

## 6.2 At the social and aesthetic level:

The green roofs can be used as an open recreation space close to the population, increasing the aesthetic value of the building. Such these roofs give the city a special distinctive character, which is why some gardens were incorporated under the science of urban landscape design or coordination of sites.

## 6.3 At the economic level:

The green roofs increase the lifetime of the building as it considered as a thermal insulator that blocks the ultraviolet rays from the buildings roofs (Serpil, 2014).

So, the building lifetime can be increased by more than 200%. Moreover, The Green Roof Research Center at Penn State University in Canada expects that the building lifetime can be increased three times more after applying the greening roof system, in addition to the following:

- It reduces the high costs of heating and conditioning.
- It Increases the value of buildings by increasing the building lifetime expected.

The beautiful view these roofs add from the top; where the property amount is estimated to increase by about 7% (GSA, 2011).

Similarly, planting gardens on rooftops is considered as one the small investment projects that can be carried out by many groups of society. The green roofs can be cultivated with medicinal, aromatic and ornamental plants, which can bring a reasonable revenue for the family( Shah, 2011).

. This small project helps to reduce the unemployment rates, especially among women with intermediate education, and solve the food crisis in most densely populated neighborhoods that are planting the roofs with food plants, in addition to it gives an aesthetic view to the building and the region as a whole.

## 7. Analytical Study

Some green roofs models that have already been applied in residential buildings and public corporations will be analyzed.

### 7.1 Global Models:

#### 7.1.1 The green roof of the Humber River Hospital in Canada

It is one of the the first digital characterized by 13006.24 m<sup>2</sup>, which rooms and treatment




Fig.8. one of the Humber River Hospital buildings (<http://www.greenroofs.com>).

Humber River Hospital buildings. It is building in the world Fig.8. It is mostly having another roof with an area of can be seen from most of the patients' areas in the hospital, covering more than

17 different levels of descriptive project of Table 1. descriptive buildings

the building Table 1. Show the the Humber River Hospital buildings. project of the Humber River Hospital

Location	North-West of Toronto city
Owner	Royal University of Toronto
Completion Date	2015
Project components	<p>It is a tower composed of 14 floors, with a capacity of 656 beds and an underground parking space of 2,000 cars, serving more than 850,000 people Fig.9.</p>  <p>Fig.9. components of Humber River Hospital buildings (<a href="http://www.greenroofs.com">http://www.greenroofs.com</a>)</p>
Project objective	Designing and building the hospital according to US energy and environmental design criteria, taking into account the optimal use of energy and water resources and reducing Global Warming gas emissions( <a href="http://www.greenroofs.com">http://www.greenroofs.com</a> ).
Green roof type	<p>Using the extensive green roofs which use a light layer of soil and a layer of grass that does not require a great depth within the soil, consisting of:</p> <ul style="list-style-type: none"> <li>▪ Root barrier and drainage layer.</li> <li>▪ Filter layer to prevent the landslide.</li> </ul>
Characteristics of project	<ul style="list-style-type: none"> <li>▪ Efficient use of energy, where the building uses less than 40% of the energy amount provided by the National Energy Act of Canada.</li> <li>▪ Efficient use of water, by reducing its consumption and utilization of rainwater.</li> <li>▪ Reducing the impact of heat emission thanks to the green areas planted on the roofs amid a large area of buildings and parking.</li> </ul> <p>The contribution of green roofs in providing psychological comfort to the building's users, patients, visitors and employees(<a href="http://www.greenroofs.com">http://www.greenroofs.com</a>).</p>

### 7.1.2 The green roof of the Faculty of Fine Arts in Singapore

This building is land surrounding it integrated with the behind a high art areas under the studios for sound galleries. The idea completed with the creation of middle





Fig.10. The green roof of the Faculty of Fine Arts in Singapore(<https://al>)



considered as a natural extension of the Fig.10. , its creative and curved lines urban environment and the green spaces painting, through explaining the large green surface in creating spaces for recording, study rooms, library and art was to surround the building to be idea of planting The roof with the space between the three buildings to



assemble the students and the faculty professors, in addition to a space for student gatherings above building roof(<https://alwitra.de/pdf>). Table 2. Show the descriptive project **of the Faculty of Fine Arts in Singapore**

Table 2. descriptive project **of the Faculty of Fine Arts in Singapore**

Location	
Owner	Nanyang Technological University
Completion Date	2006
Owner	CPG for Engineering Consultancy.
Project components	<p>The building is composed of three separated buildings in the form of arcs Fig..11., like crescent-moon, with the roof covered with planting plants and trees.</p>  <p style="text-align: center;">Fig..11. three separated buildings.</p>
Project objective	Helping the students of the Faculty of Fine Arts to take advantage of this green roof.
Green roof type	<p>Using the extensive green roofs system, consisting of a root barrier and a drainage layer Fig.12., in addition to a filtration layer to prevent the landslide, using a light layer of soil and a layer of grass that does not require great depth inside the soil.</p>  <p style="text-align: center;">Fig.12. extensive green roofs system</p>
Characteristics of project	<ul style="list-style-type: none"> <li>▪ It provides the daylight throughout the studios and classrooms, making it a productive environment for students(<a href="https://alwitra.de/pdf">https://alwitra.de/pdf</a>).</li> <li>▪ It reduces the solar gain and convection while allowing the daylight.</li> <li>▪ The glass walls provide a visual interchange between the interior places and the</li> </ul>

	<p>surrounding landscape or the interior courtyard as flexible spaces.</p> <ul style="list-style-type: none"> <li>▪ It not only enhances the visual vision but creates a common interactive environment for students at night; as the building shines like a lampshade and interior lighting through the glass wall Fig.13.</li> </ul>  <p>Fig.13. lighting through the glass wal.</p> <p>landscaped with elegant wall curtains. All of these features add to the building exceptional attractiveness and transparency.</p> <ul style="list-style-type: none"> <li>▪ It provides the building insulation and ambient air cooling.</li> <li>▪ It benefits from the harvesting of rainwater and benefits from it in irrigating the green areas (<a href="https://alwitra.de/pdf/">https://alwitra.de/pdf/</a>).</li> <li>▪ The project offers many benefits that are in line with the objectives of the Faculty of Arts to be inspiring for creativity; as the green roofs are great places to monitoring, consideration Fig.14., meditation, and creativity, in addition to giving an opportunity for mental comfort, enriching the imagination and creativity among students. The arched green roof is unusual; the garden is landscaped with elegant wall curtains. All of these features add to the building exceptional attractiveness and transparency.</li> </ul>  <p>Fig.14. the green roofs are great places.</p>
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## 7.2 The green roofs in Egypt


The concept of planting gardens on rooftops has only recently been applied in Egypt. In the early 1990s, a group of professors of the Faculty of Agriculture at Ain Shams University developed an initiative to develop organic vegetables to be fitted with the densely populated cities in Egypt. The initiative was implemented on a limited scale until it was formally adopted in 2001 by the Food and Agriculture Organization of the United Nations (FAO). Many case studies represent the success of projects carried out by various NGOs, public and civic institutions of initiatives(Reham, 2018 ).

### 7.2.1 The green roof in Al- Zawia Al-Hamra district:

Egyptian President Mohamed Anwar Al Sadat founded Al-Zawia Al-Hamra district to accommodate the inhabitants of the Turgoman and Boulak El Dakror districts, who were transferred to the Al-Zawia Al-Hamra housing Fig.15. Al-Zawia Al-Hamra was named by this name because of the existence of a small corner (mosque) which was painted with the red color at the beginning of founding this district. Al-Zawia Al-Hamra was initially affiliated to the ancient district of Shubra, but it was separated from it in the 1980s, like other districts that recently separated from Shubra. The area of Al-Zawiya is now under private ownership – owned by Mrs. Zeinab Hanim Khatoun, a member of the ruling family. After the revolution and the beginning of 1953, the urban extension began to reach this place; where it was all considered as agricultural land. There are still remnants of this land existed behind the district building, and adjacent to the military plant, it is estimated about (70) acres.

The Cabinet Decree No. 385 of 1998, concerning separating the Sharabiya district from Al-Zawia al-Hamra one, was issued on 15/04/1998. The estimated population at 01/07/2010 is about 338341 people, the total area is 8.86 km<sup>2</sup>, and the inhabited area is 2.70 km<sup>2</sup> (<http://www.cairo.gov.eg/areas/DistDeta>) Table 3. Show the descriptive project Al-Zawia Al-Hamra- A slum

Table 3. descriptive project of Al-Zawia Al-Hamra- A slum


Location	Al-Zawia Al-Hamra- A slum, located at North Cairo, Cairo governorate.
About the project	The project is a collaboration between USAID, represented by Aga Khan, and the faculty of Agriculture, Ain Shams University, who organized training courses to teach agriculture for citizens
Project objective	The purpose of the project is economic. Because the idea of the project is based on providing a food source for the residents of the district and selling the surplus to provide a source of income; to help the low-income citizens to plant some vegetables on the roofs of their homes to meet a part of their needs, but over time attracted a number of rich and middle class citizens to convert houses into gardens.
Green roof type	A wood-roofed farm is a plastic container filled with algae or soil. Irrigation is done through small plastic hoses. This system produces lush crops such as parsley Fig.16., radishes, and carrots. The cost per square meter of this method is about 400 Egyptian pounds. <div style="text-align: center;">  </div> <p>Fig.16. Al-Zawya Al-Hamra green roof farms (Laboratory for agricultural climate Central</p>
Characteristics of project	The project aims at helping low-income people. It helps to properly use the urban space, in light of increasing the population and elevating the lands price.

### 7.2.2 The project of " Bashayer Al- Khair" city in Alexandria

The city of Bashayr Al-Khair was established by the President Abdel-Fattah Al-Sisi in the recent period in Alexandria; to develop slums, with an area of thousands of meters Table 4. Show the descriptive project of Bashayr Al-Khair city – Alexandria.

Table 4. descriptive project of Bashayr Al-Khair city – Alexandria.

.	Bashayr Al-Khair city – Alexandria.
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Location	
About the project	It is an experiment that has been fully disseminated; so that each roof is allocated to a specific type of plants even, taking one effort, under the supervision of the northern military region.
Project objective	Economic project to help the low-income people. Creating job opportunities for young people and homemakers.
Green roof type	The strawberries, tomatoes, melons, marries, rosemary, chili pepper, watermelon, cabbage and whatever you want to eat fresh were cultivated, and it is accessible to everyone, without fearing of carcinogenic pesticides, high prices or the greed of traders Fig.17. 
Characteristics of project	The project is still being experimented[ (Hana .2017 ) Fig.17. Bashayr Al-Khair )2017 .Hana (project

There are other projects such as Al-Darb Al-Ahmar project, the roof-planting project adopted by the faculty of Agriculture, Mansoura University, the Child Academy Project in Maadi (Nursery) - which is considered now a bad image because of negligence and lack of maintenance- and the roofs of Toura city, which is a group of a slums.

### 8. Obstacles facing application of green roofing:

1. The initial cost of installing green roofing is considered one of the major obstacles that prevent using it, as it is possible that the initial cost is double the cost of the normal roof but the cost of green roofing varies according to the type of systems and depth of required insulation.
2. Maintenance of green roofing constitutes important factor as the maintenance depends on the used roof type. Regarding intensive green roofing that is similar to gardens shape requiring the same level of maintenance like removing harmful grass and mowing processes that maintain the type of planted flowers in addition to irrigation and fertilizer application processes.
3. Non-standardization of green roofing system within local planning policies despite some countries around the world took some procedures to promote these roofs.
4. The non-existence of common standards or measurements used to evaluate techniques of green roofing.
5. Damage to the roof because of leakage of rainwater as some green roofing requires higher requirements from the insulation system because of the stored water on the roof as well as the possibility of roots penetrating the waterproof membrane

6. Attracting many small insects and rodents that could get in the residential building through open windows.
7. Lack of existing buildings that can resist these large amounts added to the weight of the building especially intensive roofs that have an additional block of soil and stored water. That constitutes a big load on the building's structure as well as the cost resulting from supporting buildings to be able to resist these loads. Also, some types of roofs require special design requirements.
9. **Factors encouraging the application of Green roofing system:**

Several factors encourage to use of green roofing systems, such as:

1. Reconstruction phase of many buildings and facilities enables the green roofs to have a great opportunity to be applied to new construction projects.
2. High prices of medicinal and aromatic plants could be motive for citizens to seek to cultivate roofs to secure their financial requirements as it is a good chance for investment and work for homemakers.

#### **10. Results:**

1. Given the psychological pressure on the citizen resulting from the current different burdens and increase of population density rates and small spaces of residential units as the space of the residential unit in social residence is 70 m<sup>2</sup>, the city became in more need for recreation services whatever his social, cultural or financial level.
2. Roofs cultivating in Egypt whether for the aesthetic or economic objective is expensive.
3. The aim of all projects (Al-Darb Al-Ahmar, Al-Zawya Al-Hamra, Children Academy in Maadi, Bashayer Al-Kheir Project in Alexandria, Project of Roofs Beautification in Mansoura) of roof cultivating in Egypt is economical and limited to providing a food source, income for the families of the district, providing job opportunities and environmental cleanliness.
4. The majority of the buildings with cultivated roofs lasted for a short period because of lack of maintenance and high costs leading to ignoring it such as the garden of children academy in Maadi.
5. Roof garden, from the urban aspect, is considered open urban space connected to nature directly, as it is external space with functions not practiced unless in open spaces. While a special space for the resident it has functions that do not practice in open spaces and need kind of privacy at the same time, it also considered alternative for open spaces green spaces that could not be provided now whether because of the high process of land intended for construction.
6. Possibility to accommodate green roofs within the boundaries of the urban space in districts with high-intensity population and concrete roofs.
7. Neglect of surface insulation can lead to water leaking into concrete, which threatens the roof of rusting iron and breaking the concrete roof.
8. The government only is not able to provide required spaces to establish urban spaces and green surfaces. Even if these spaces existed, the government would not be able to establish it without the help of inhabitant or beneficiaries.
9. All private projects of green roofing in Egypt were done by efforts of associations, external grants or self-efforts of the inhabitants.

#### **11. Recommendations:**

1. When thinking about upgrading and developing a particular area, the priority should be given to finding green and open spaces to keep the area clean continuously.
2. Cooperation between specialists in the application of green roofing will increase the per capita of green areas in the form of roof gardens.
3. Successful experiments in green surfaces should be spread over slums and areas with high population density.
4. Cooperation between a specialized team composed of (architecture, construction, and agricultural orchard) engineers.

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