

# ANALYSIS OF CONTRIBUTION OF VERTICAL GARDENS TO URBAN SUSTAINABILITY: THE CASE STUDY OF ANTALYA CITY, TURKEY

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## ABSTRACT

Vertical garden's studies, having been defined a new perspective to the modern construction culture, has been application of the garden to a building facade or to a wall surface as a notion. Application of plants to the vertical surfaces make contributions to urban ecology due to its functions such as aesthetical and visual values as well as protection of the buildings, habilitating the climate effects for human beings, enhancing the environmental aspects and reducing certain ambient problems. The aim of the study is to determine the ecological, aesthetical and economical benefits of vertical garden applications which are used in the Antalya City where has been an important tourism center of Turkey since the 1980s. To this end, the samples of vertical garden and their relations with tourism developments in the city have been investigated. It is also considered that the study will be contributing to the cities, where vertical garden applications have not started, yet.

**Keywords:** Antalya City, Turkey, urban sustainability, vertical garden

## DİKEY BAHÇELERİN KENTİN SÜRDÜRÜLEBİLİRLİĞİNE SAĞLADIĞI KATKILARIN İNCELENMESİ: ANTALYA KENTİ ÖRNEĞİ

## ÖZET

Çağdaş yapı kültürüne yeni bir anlayış getiren dikey bitkilendirme çalışmaları konsept olarak bahçe olgusunun bir bina cephesine ya da duvar yüzeyinde uygulanmasıdır. Yapılarda dikey yüzeylerin bitkilendirilmesi, estetik ve görsel değerlerin yanında, yapıların korunması, iklim etkilerinin insan için daha uygun hale getirilmesi, çevre koşullarının iyileştirilmesi ve bazı çevre sorunlarının azaltılması gibi işlevleri nedeni ile kent ekolojisine önemli katkılar sağlamaktadır. Bu çalışmanın amacı; 1980li yıllardan bugüne Türkiye'nin önemli bir turizm kenti olan Antalya kentinde son uygulanan dikey bahçe örneklerinin kente sağladığı ekolojik, estetik ve ekonomik faydanın tespit edilmesidir. Bu amaçla kent içinde yapılan dikey bahçe örnekleri ile turizm yapılarında yapılan dikey bahçe örnekleri incelenmiştir. Çalışmanın henüz dikey bahçe uygulaması başlamamış kentlere katkı sağlanacağı düşünülmektedir.

**Anahtar Kelimeler:** Antalya kenti, Türkiye, kentsel sürdürülebilirlik, dikey bahçe

## 1. INTRODUCTION

Urbanites, who are living under the pressure of constructed surroundings, are lacking each and every day green lands such as parks, gardens, etc; where they can actually take a clean breath. Therefore, they ought to continue their daily lives between constructions, buildings and pavements which at the same time keep them away from nature. Important points of the global agenda are to create more green lands in the urban areas, taking every chance to integrate with nature and protection of natural resources. Actually, certain subjects such as the future of natural resources and their protection, environmental problems and global climate changes do increase the sensitivity to "green" in constructed

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areas which also directs the studies on creating urban areas with natural ambient conditions. Plants play an important role in today's cities where the rampant urban development is causing many problems such as pollution, increased air temperature, lack of green space and excessive energy consumption. Following the concepts of sustainability, urban greening practices are becoming a popular way of reducing the undesired effects of increasing construction and achieving ecological goals. Nowadays, greenery systems offer the potential to incorporate advanced materials and new technologies to promote sustainable building functions.

Vertical gardens which have been bringing a new understanding to modern cities and culture of structure have been applied to the walls or building facades especially with the planting design approach in the traditional garden sense.

In the 21st Century, one of the biggest challenges will be to bring nature into urban areas and perhaps, the most effective and spectacular resolution will be the vertical garden (Shiah and Kim, 2011). Vertical green or 'green walls' or 'living walls' is a popular item of sustainable development for a better environment related to dense urban areas (Mir, 2011). These dense urban areas are causing considerable environmental degradation in the previously undeveloped landscape (Ottel  et al., 2011).

As the interest restoring the environmental integrity of urban areas continues to increase, new developments in construction practices with beneficial environmental characteristics take place, as vertical gardens (Perini et al., 2011).

Living wall systems, which are also known as green walls and vertical gardens, are constructed from modular panels, each of which contains its own soil or other artificial growing mediums, as for example foam, felt, perlite and mineral wool, based on hydroponic culture, using balanced nutrient solutions to provide all or part of the plant's food and water requirements (Dunnet and Kingsbury, 2004).

The living wall, the vertical garden, is great for urban areas or dry and arid areas because the garden makes great use of vertical areas, which are abundant in cities, and allows for less evaporation than horizontal gardens [6].

Living walls or vertical gardens can be defined as any man made three-dimensional vertical surface covered in vegetation (Elinç et al., 2013). Some ecological, aesthetic and environmental benefits from vertical gardens to urban space are as follows;

- Energy saving,
- Carbon emission,
- Oxygen production,
- Sound insulation,
- Location acquisition,
- Supplying space for wildlife,
- Dust retention,
- Reducing the impact of rainwater,
- Creating agricultural area (vertical farming),
- Making people feel good, and
- Valorization

Architects and other design disciplines are trying to create green areas around the residential areas, and they try to create new configurations of green. Since the outer surfaces of buildings offer a great amount of space for vegetations in urban cities, planting on roofs and walls has become one of the most innovative and rapidly developing areas in the horticulture and the built environment (Mir, 2011).

The objective of the study is to investigate the ecological, aesthetical and economical benefits of vertical gardens which have been applied to two sample areas, a shopping mall and a hotel, in Antalya where has been an important tourism centre of Turkey since the 1980s. Since tourism is an important industry in Antalya, city aesthetics should be very important in Antalya and similar cities. The results of the study will be contributing to the cities where vertical garden applications have not started.

## 2. MATERIAL AND METHOD

Since the 1970s, there has not been important hotel construction in Antalya Region. After the 1980s, especially in 1984 and 1985, an important step has been taken to mass tourism in Antalya Region (Figure 1) with the opening of four new large holiday club. According to Ulusoy (1986), opening of the Antalya International Airport has played an important role in tourism development since 1985.



Fig. 1. Tourism map of Antalya (GüniziDPI, 2010)

In the last three decades, tourism has been reached incredible levels in Antalya. One third of four thousand hotels in Turkey have been located in Antalya (Demir, 2013). A tourism expert, Fehmi Köfteoğlu, has been stated that the number of five star hotels in Antalya much more than the number of five star hotels in entire Spain (Tourismtoday, 2013).

In the study, the vertical gardens in Erasta Shopping Mall (350m<sup>2</sup>) and SENTIDO Zeynep Resort Hotel (461m<sup>2</sup>) have been chosen in Antalya which is called as a capital city of tourism in Turkey.



a. before



b. after

Fig. 2. The vertical garden application on the Erasta Shopping Mall, Antalya-Turkey



Fig. 3. The vertical garden application on the SENTIDO Zeynep Resort Hotel, Antalya-Turkey

With these two samples, it has been tried to explain the aesthetical and ecological benefits of vertical gardens to the irreversible cementation in the city.

### 3. FINDINGS

In the study, it has been determined the effect of vertical gardens to the city if they have been set up to 200m<sup>2</sup> of each of about 1,400 hotels and 450m<sup>2</sup> of each existing 10 shopping malls.

In the first stage of the study, the amount of the planted plants has been calculated per square meter. If the module on the SENTIDO Zeynep Resort Hotel (Figure 3) has been used, 60 plants per square meter would be used. If the module on the Erasta Shopping Mall has been used, 21 plants per square meter would be used. Currently, Erasta Shopping Mall (Figure 2) has been received Leed Certificate because of using the vertical garden on its walls.

In the study, the module (Figure 4) that has been used on the SENTIDO Zeynep Resort Hotel has been chosen because it takes more plants. This module is the most effective and practical installation system currently available. While the plants are being grown in the modules at a separate location, the stacking and irrigation systems can be completely constructed and tested.

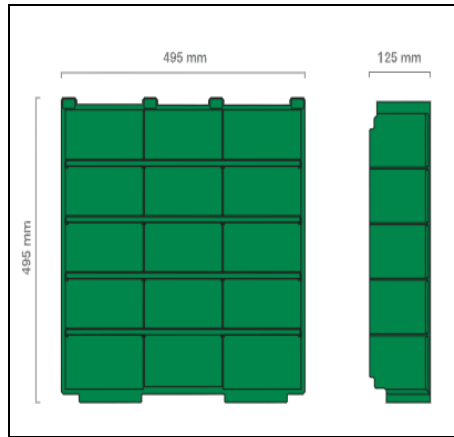


Fig. 4 The preferred module [7]

This preferred module, vertical walls with planting module, (Figure 4) is the most recent living wall design. Each module consists of a 2.4 kg PPC material, measuring 495 mm x 495 mm in size and 125 mm thick. With this design, the planting system may better meet the architectural requirements since the modules may be cut vertically and horizontally to fit the adjacent facade. In addition, because the modules are well designed, they provide a smooth finish at the corner joints of the walls. The modular structure of this system also makes partial disassembly possible; any module can be easily taken out for repair or to change out the plants and then reinstalled.

Table 1 shows that if this module has been used on all hotels and shopping malls in Antalya, the amount of green lands and plants will be increased.

Table 1. Proposed increment of the amount of green lands and plants after the usage of vertical gardens on hotels and shopping malls in Antalya

Place	Numbers	Vertical garden (m <sup>2</sup> )	Amount of plants each m <sup>2</sup>	Total vertical gardens (m <sup>2</sup> )	Total amount of plants
Hotels	1,400	200	60	280,000	16,800,000
Shopping Malls	10	450	60	4,500	270,000
Total				284,500	17,070,000

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The resulting figures are the numbers if the vertical gardens applied to around 1,400 hotels and 10 shopping malls in the City of Antalya. If public buildings and high-rise apartment buildings have been added to this calculation, the numbers which will change the entire ecology of Antalya might arise.

Nowadays, this kind of study can be possible in Antalya, because the EXPO 2016, with the theme of “Flower and Child,” can organize and finance this study.

### 4. CONCLUSION

Today, many conscious tourists prefer eco-friendly hotels. Therefore, if the ecological, economic and aesthetic contributions of vertical gardens are explained to the hotel operators, they will want to use this system. Furthermore, local authorities might impose the at least 100m<sup>2</sup> vertical gardens to the facades of newly constructed buildings.

As a result, if even half of the considered vertical gardens in the study are implemented, nature of the city of Antalya will have made a good improvement.

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