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Vertical Garden Design in Case of Ankara Sıhhiye Bridge and Closed Area

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Abstract

By the year 2050, it is estimated that will live in urban center's about 80% of the world's population. There are several disadvantages to living in cities as well as many advantages. The most important of these disadvantages; people who are a part of nature move away from nature because of crowding and building in cities. People who move away from nature are experiencing many psychological problems such as stress. Vertical gardens are very important its ecological benefits and the advantage of creating the natural areas in the most congested and structural areas of the city.

Vertical gardens have numerous benefits in cities. One of the most important benefit for humans is that they create natural areas and remove stressful and structural life in the cities. The areas where vertical gardens can be applied at the easiest and least cost in the cities are the walls and bridges in the cities.

In this study; Vertical garden samples applied in the world are examined. For example; İstanbul, Trabzon, Ankara, Southern France, Bengaluru, etc. and the plants have been determined that can be used in the vertical gardens in the Central Anatolia region. As a result of the study, a vertical garden design was prepared for Ankara Sıhhiye bridge and its surroundings, which had a bad appearance due to its structure. This study will set an example for other cities located in semi-arid and arid regions.

Keywords: Ankara, Sıhhiye Bridge, Vertical Gardens, Landscape Design

Ankara Sıhhiye Köprüsü ve Yakın Çevresi Dikey Bahçe Tasarımı

Özet

2050 yılına gelindiğinde dünya nüfusunun yaklaşık % 80'inin kent merkezlerinde yaşayacağı tahmin edilmektedir. Kentlerde yaşamanın birçok avantajı olduğu gibi bazı dezavantajları da bulunmaktadır. Bu dezavantajlardan en önemlisi; doğanın bir parçası olan insanın kentlerdeki kalabalıklaşma ve yapılaşmadan dolayı doğadan uzaklaşmasıdır. Doğadan uzaklaşan insanlar yapısı gereği stres gibi birçok psikolojik sorunlar yaşamaktadır. Bu noktada hem ekolojik faydaları, hem kentin en sıkışık ve yapısal alanlarında doğal alanlar yaratmaktaki avantajı ile dikey bahçeler ön plana çıkmaktadır.

Dikey bahçelerin kentlerde sayısız faydaları bulunmaktadır. Bu faydalardan insanın kendisi için en önemlilerinden bir tanesi, doğal alanlar yaratarak insanları kentin stresli ve yapısal yaşantısından uzaklaştırmasıdır. Dikey bahçelerin kentlerde kolay ve en az maliyetle uygulanabileceği alanlar ise kentlerde bolca bulunan duvarlar ve köprü ayaklarıdır.

Bu çalışmada; Dünyada kentlerde uygulanan dikey bahçe örnekleri incelenmiş, İç Anadolu Bölgesi'nde dikey bahçelerde kullanılabilecek bitkiler belirlenerek, başkentin merkezinde bulunan yapısı ile kötü bir görüntüye sahip olan Sıhhiye köprüsü ve çevresi için dikey bahçe tasarımı gerçekleştirilmiştir. Bu çalışma ve tasarım yarı kurak ve kurak bölgelerde bulunan diğer şehirler için örnek teşkil edecektir.

Anahtar Kelimeler: Ankara, Sıhhiye Köprüsü, Dikey Bahçeler, Peyzaj Tasarımı

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1. Introduction

It is observed that the amount of green area decreases considerably due to the increase of building construction activities in the cities. There are many reports that the green areas in the world are diminishing (Baycan et al., 2009, Han et al., 2009, Rafiee et al., 2009). According to the The European Environment Agency [EEA] (2013) report, significant reductions in the amount of green space in Europe have been observed. Demir (2004) and Yağcı (2006) noted that, green areas gradually decreased due to dense housing in Turkey. Besides, there are some studies (Özcan 2000, Uz 2005, Albayrak 2006, Özdemir 2007, Öztürk Levend 2008, Atabeyoğlu and Bulut 2012) about decreasing the amount of open-green areas per capita in some cities (ex. İstanbul, Gaziantep, Eskişehir, Ordu, Çorum, Kırıkkale) of Turkey. Therefore, the decline in the proportion of green spaces in cities has forced researchers and urban planners to create alternative green surfaces. Having some features such as not covering spatial space in plan, enhancing urban aesthetics and visual quality make vertical gardens the most important alternative that can be used to create green spaces within the city.

Although vertical gardens have some negative aspects such as high cost, maintenance difficulties, irrigation system problems (Ekren 2016), there are many benefits that are known around the urban scale and around the dwelling. Vertical gardens have functions such as energy saving in houses, sound insulation, improvement of indoor air quality, protecting the building from external factors as well as having various ecological benefits such as reducing carbon dioxide emissions, reducing the impact of urban heat island, improving urban air quality, retaining dust particles, and increasing the amount of green space in urban areas (Örnek 2011).

When the literature on the topic is examined; it has been seen that some studies (Erdoğan et al., 2008, Elinç and Elinç 2010, Aygencel 2011, Örnek 2011, Timur and Karaca 2013, Yuksel 2013, Beyhan 2014, Kanter 2014, Üçok 2014, Uslu 2015, Ekren 2016, Ekren 2017) were carried out in our country and most of these studies have concentrated on the selection of plant species in vertical gardens and the examination of examples of vertical gardens in Turkey and in the world. Otherwise, there are few studies (Johnston and Newton 2004, Morrison and Sweet 2011, Carpenter 2014, Jain and Janakiram 2016) around the world related to the subject. In addition to this, due to lack of work on vertical garden design, being limited on design model proposal and on the structural and ecological characteristics of vertical gardens of related works (Beyhan 2014, Uslu 2015), the absence of a workshop of vertical garden design work on a designated area and the absence of development of alternative design drawings and recommendations (Örnek 2011) has been observed as a major deficiency in the literature.

In the study which was prepared by way of this lack in the literature, Sıhhiye Bridge, which is used extensively in the capital of Turkey and which has historical importance and provides connection between many settlements and center Kızılay, was chosen as a study area. Areas that suffer from heavy traffic, dust and noise pollution problems emerges as the areas that requires intervention in terms of urban comfort and public health. Execution of vertical garden design and practices in these areas which are heavily used by the public is seen as an important step to increase the quality of urban life.

On the other hand, in the study carried out at the Ankara Sıhhiye Bridge, plant species which are suitable for use in bridge walls and can adapt to the climatic conditions of the Central Anatolia Region were identified and also vertical garden design studies were carried out to develop alternative design proposals. In this context, by designing a vertical garden that suits the climate and environmental conditions of the region , it has been aimed to put into practice the study in a correct and practical way along with sustainability approaches thanks to developed alternative drawings and suggestions. The study will give an aesthetic appearance to the area, through vertical garden designs that will be recommended in. The study that was carried out has an extremely important task with its post-implementation gains and benefits, and it is thought that the study will provide important contributions to the literature in this respect.

2. Materials and Methods

The material of the study is the Sıhhiye Bridge and plants for using vertical gardens. In the study, primarily the literature on vertical gardens was examined and deficiencies in the literature were identified. Then, the study was carried out in two stages. In the first step, 331 plant species which can be used in vertical gardens in terms of their physical characteristics have been determined by searching literature on the subject. Specified species were investigated in terms of suitable growth temperature values with the aid of the USDA Plant Hardiness Zone Map, which was prepared by the US Department of Agriculture. It was compared with the minimum and maximum temperature values measured in the Central Anatolia Region between 1926-2016. In the study where the living conditions of the city were also evaluated, 42 species were determined for the design study by excluding the leaves or fruits and the species that might be harmful to humans. Total working surface area is

15000 m². The planning vertical garden area is feet of the 60 m. wide bridge, feet of the 18 m. wide U-bridge and the idle vertical surfaces. In this area There are 7 U-bridges feet with a total area 1000 m², 32 bridges feet with a total area of 240 m² on the other bridges and have 600 m² area vertical surfaces under the bridges.

In the second stage, the vertical vegetation design was carried out for the Sıhhiye Bridge which has an ugly and cold appearance in Sıhhiye that is an important connection point in the city, by using the species evaluated in terms of color properties and solar demand for the area. During the design phase, the Google Earth image was examined with in-situ detection and analyzed with photos taken in the field. With Cubicon 3D printer, some sections of the bridge model have been made and planting design has been created according to the view. AutoCAD 2017, Sketch up 2015 and Lumion 6.0 programs were used for the planting design.

3. Results and Discussion

3.1. Vertical Garden Designs on the Bridges in the World

The planting studies in the cities where it is applied on the bridge legs in the world prevents dust, noise and air pollution and increases both oxygen and the amount of green space as well as having the two most important benefits; transforming the ugly view into aesthetic and natural image and rehabilitating the urban psychology. For this reason, like İstanbul, Trabzon, Ankara, Southern France, Bengaluru, etc. vertical gardening work is being applied on bridges and overpasses in many countries of the world and in many cities of Turkey.

When studying the up-to-date and comprehensive study of the vertical garden of the bridge in Mexico City, it has been seen in the study which carried out in Via Verde that 40000 m² of vertical garden was constructed on 700 bridge legs at a distance of 30 kilometers (Figure 1). During and after the implementation of the project, hundreds of jobs were provided and at the same time 25,000 dwellings were provided with oxygen.

Figure 1. Via Verde Vertical Gardening Study (URL1, 2017)

3.2. Plants That Can Be Used For Vertical Gardens in Central Anatolia Region

In terms of physical characteristics, 331 plant species that could be used in vertical gardens have been identified. A list of the specified species was created. In the determination of plant species; Orçun (1972), Johnston and Newton (2004), Aygencel (2011), Morrison and Sweet (2011), Timur and Karaca (2013), Yüksel (2013), Beyhan (2014), Carpenter (2014) , Üçok (2014), Uslu (2015), Anonymous (2016), Ekren (2016), Jain and Janakiram (2016) and Anonymous (2017) were utilized. Specified species were examined in terms of appropriate plant tolerance values with the aid of the USDA Plant Hardiness Zone Map, which was prepared by the US Department of Agriculture. These tolerance values have been determined from various plant databases surveyed worldwide (URL3, 2017; URL4, 2017; URL5, 2017; URL6, 2017; URL7, 2017; URL8, 2017; URL9, 2017). The determined tolerance temperature ranges are compared with the minimum and maximum

temperature values (MGM 2017) measured in the Central Anatolia Region between 1926-2016 obtained from the General Directorate of Meteorology. As a result of the evaluation made, 212 species were selected which are in the range of the minimum and maximum temperature of Central Anatolia Region from the 331 species listed in. In the study where both the living conditions of the city and the climatic conditions of the region has been evaluated, these 212 species that may be harmful with their leaves or fruits to humans were excluded from the list . As a result, the vertical garden plant species list consists of a total of 42 species (Table 1). Vertical garden design studies have been carried out by using these types which are evaluated in terms of color characteristics and solar demand.

Table 1. Sıhhiye Bridge Vertical Garden Design Plant Species List (Orçun, 1972; URL3, 2017; URL4, 2017; URL5, 2017; URL6, 2017; URL7, 2017; URL8, 2017)

TYPE	NO	PLANT NAME	SHADOW	PENUMBRA	FULL SOLAR	FLOWER COLOR
IVY and CLIMBERS	1	*Actinidia kolomikta*		x	x	Leaves pink-white-green
	2	*Akebia quinata*		x	x	Chocolate-violet-blue
	3	*Bignonia capreolata*		x	x	Orange - red
	4	*Clematis alpina*		x	x	Light purple-blue
	5	*Clematis armandii*			x	Creamy white
	6	*Clematis campaniflora*		x	x	Shadow blue-white
	7	*Clematis dioscoreifolia* var. *Robusta* (*Clematis terniflora*)		x	x	Creamy white
	8	*Clematis flammula*			x	White
	9	*Clematis montana*		x	x	White
	10	*Clematis rehderiana*		x	x	Pale yellow
	11	*Clematis tangutica*		x	x	Light yellow
	12	*Clematis viticella*		x	x	Purple-blue
	13	*Euonymus fortunei* var. *Radicans*	x	x		-
	14	*Hedera helix* 'Contraindicaciones'	x	x		-
	15	*Hydrangea petiolaris*	x	x		White
	16	*Jasminum nudiflorum*		x	x	Light yellow
	17	*Lonicera japonica*		x	x	White- matt yellow
	18	*Parthenocissus quinquefolia*		x	x	The leaves are dark red in the autumn
	19	*Polygonum aubertii (Fallopia baldschuanica)*		x		Creamy white
	20	*Polygonum bauldschianicum*		x		Light pink-white
HERBACEOUS PLANTS	21	*Acantholimon echinus*			x	Pink-White
	22	*Acorus gramineus*		x	x	-
	23	*Adiantum venustum*	x	x		-
	24	*Ajuga reptans*		x	x	Purple-blue
	25	*Aloe aristata*		x	x	-
	26	*Campanula carpatica*		x	x	Purple
	27	*Carex oshimensis* 'Evergold'		x		Brown
	28	*Carex morrowii* 'Variegata'	x	x		Brown
	29	*Corydalis cheilanthifolia*	x	x		Light yellow
	30	*Crassula expansa*		x	x	Pink-White
	31	*Cyrtomium falcatum*	x	x		-
	32	*Delosperma congestum*		x	x	Light yellow
	33	*Delosperma cooperi*			x	Bright red-purple
	34	*Dianthus ancyrensis*		x	x	Pink
	35	*Dianthus plumarius*			x	Pink-White-Red
	36	*Festuca glauca*			x	-
	37	*Gaultheria procumbens*	x	x		White
	38	*Genista lydia*			x	Light yellow
	39	*Liriope* sp.	x	x	x	Lilac-violet
	40	*Lobularia maritima*		x	x	White
	41	*Ophiopogon japonicus* 'Nigrescens'		x	x	Pink
	42	*Polystichum munitum (Aspidium munitum)*	x	x		-

3.3. History of the Sıhhiye Bridge

In the first years of the Republic, city plans of Ankara were made. The urban space was shaped according to the

Jansen plan, which was first obtained by the Lörcher plan and then by the limited international competition. The old and new touch connection was established in the Jansen Plan (1928) and it was suggested that the new city grow up by holding onto Ataturk Boulevard (Ünal 2015).

The Atatürk Boulevard, a social and spatial backbone (Keskinok 2009) that combines the new city (Yenişehir) and the old city (Ulus), which is not only a way but also contemporary life activities, started to open in 1926-1927 with the idea of connecting to the old city with Çankaya (Ünal 2015).

Afterwards the breakage of the road in Sıhhiye Square was realized and by evaluating over again the railway bridge, 30m iron bridge was made which takes place in far more west end of the line that is still being used today. The other space was closed.

Figure 2. A view from the 1960's of the Sıhhiye Bridge (URL10, 2017)

Although the exact date can not be found in any source, the Celal Bayar Boulevard (Sıhhiye Bridge) was built between 1970-1980 and the concrete rate in the area was increased seriously.

Figure 3. A view from 2000's of the Sıhhiye Bridge (URL11, 2017)

Finally, a double-lane U-turn bridge (300m long) was built by the Ankara Metropolitan Municipality in 1997(URL12, 2017). With this last bridge, in the Sıhhiye Bridge area where the people use it very intensely, concrete ratio and lack of natural space have begun to feel itself very strongly.

4. Conclusion and Recommendations

As a result of all the studies, the vertical garden design of Sıhhiye Bridge was prepared with the Lumion 6.0 Program (Fig. 4).

Figure 4. A view from Google Earth

While choosing the types used in bridge design; the ones have been noted that have shown rapid development, have low water demands, are resistant to drought and are tolerant to adverse urban conditions such as traffic pollution. To be used in one or more of the interior façades where the bridge is more exposed to semi-shade and pollution; *Polygonum aubertii* (*Fallopia baldschuanica*) with remarkable white flowers, evergreen *Hedera helix*, *Parthenocissus quinquefolia* species with impressive red leaves in autumn, *Euonymus fortuneii* var. *Radicans* species providing full occupancy on large surfaces were selected. With these 3 species' reciprocal use on both sides, produced red-green, red-white and green-white contrast in colors in summer and autumn terms (Fig. 5).

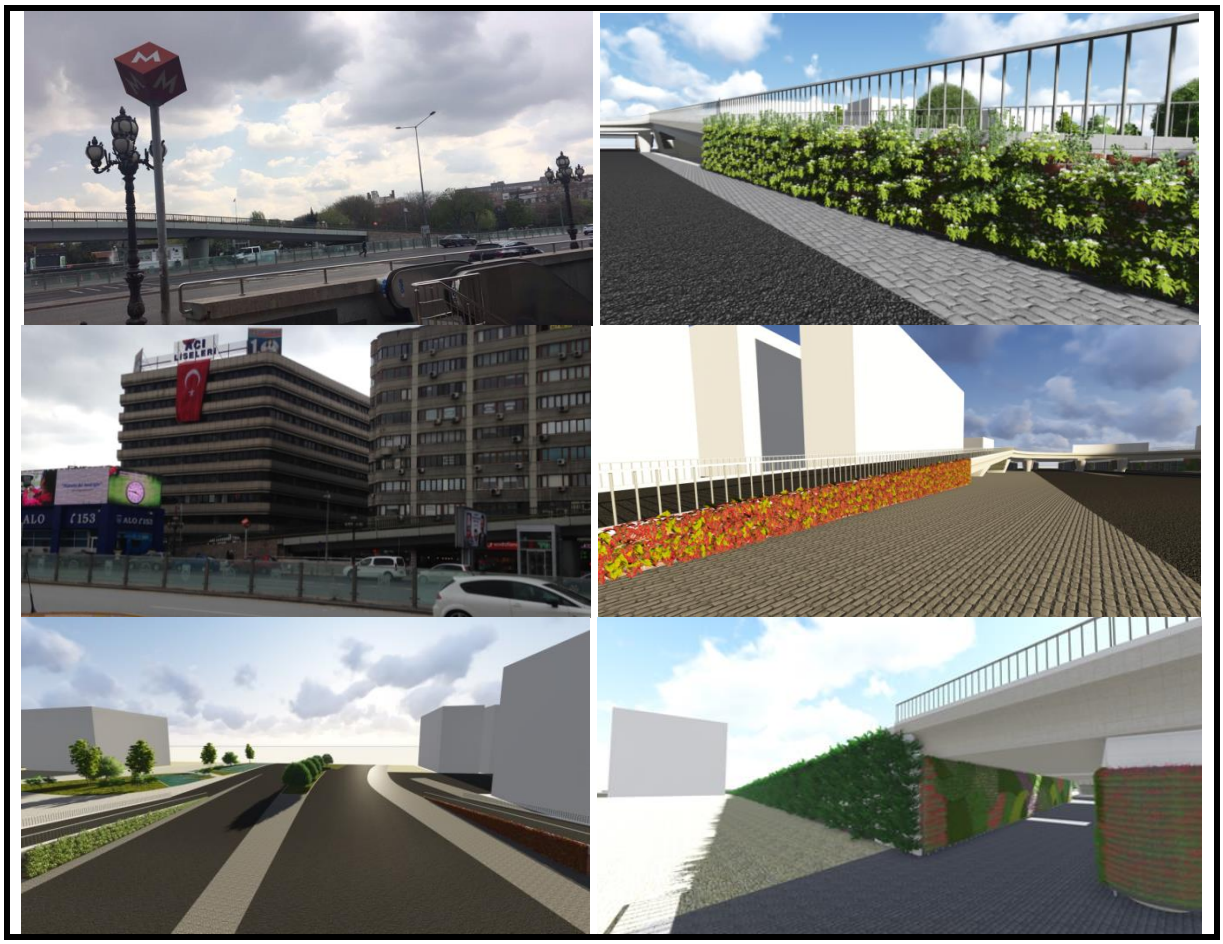

Figure 5. Vertical garden design of Sıhhiye Bridge - 1 (Original)

Acorus gramineus, Adriamus venustum, Ajuga reptans, Aloe aristata, Campanula carpatica, Carex oshimensis 'Evergold', *Carex morrowii* 'Variegata', *Corydalis cheilanthifolia, Crassula expansa, Cyrtomium falcatum, Delosperma congestum, Dianthus ancyrensis, Gaultheria procumbens, Liriope* sp., *Lobularia maritima, Ophiopogon japonicus* 'Nigrescens' and *Polystichum munitum* herbaceous plant species have been preferred which are suitable for growing in shadows and semi-shaded areas on the legs of the bridge and the inner side walls of the bridge. As can be seen in Figure 6, in the vegetative design study in which the plants were used vertically, pattern studies were carried out using various leaf and flower colors of herbaceous species which are also seen in Table 1.

Figure 6. Vertical garden design of Sıhhiye Bridge - 2 (Original)

Besides, with the use of some herbaceous species in vertical garden design, patterns created from these colors by providing purple-green and pink-green contrast. (Fig. 7).

Figure 7. Vertical garden design of Sıhhiye Bridge - 3 (Original)

Thanks to the vertical garden designs carried out with the species determined in the study, the Sıhhiye Bridge and its surroundings will have an aesthetic appearance. It is expected to have a positive impact on the quality of life and landscape aesthetics of Ankara by the implementation of proposed designs.

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