



## PLANT ERGONOMICS IN SUSTAINABLE CITIES\*

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### Abstract

Urban spaces are reliable and accessible places that allow people to socialize. Urban green areas improve people's quality of life. Creating high-quality living cities is the result of balanced spatial relationships between the open and green areas, compatible with the environment. The plants are important natural elements that add meaning to the space from aesthetic and functional point of view. However, functional and ecological conformity criteria are not aesthetic limitations. In this case it is not easy to come to a definite judgment in terms of aesthetics. Planting is a basic principle in terms of line, form, texture and color aesthetics from design criteria.

In this study, the applicability of the vegetable touch, which is the key element in the urban green spaces, was investigated in terms of ergonomics. Existing plants used in Atapark in Trabzon were evaluated according to their ergonomic design elements. In addition, according to the places of use of plants according to the anthropometric measures of people were evaluated.

**Keywords:** Plant Ergonomics, Trabzon, Urban Spaces, Green Area.

### 1. Introduction

The livability of a city is determined by the integrity of the relationship between its architectural features and its open-green spaces. Open-green spaces balance the association between human and nature and improve urban living conditions. Therefore, the amount of the green spaces in urban areas is considered as a development indicator in various countries. In this regard, several developed countries are in tendency to create urban areas suitable for urban ecology in order to meet individuals' physical, spiritual and mental needs (Gül, 2011:28-32). Urban green areas have a significant effect in the society's urbanization strategy. Specifically, they provide services in terms of the livability of the modern cities, as well as the important environmental services such as natural assets in urban areas (i.e. urban parks and forests, green belts) and their constituents (i.e. planting, trees, water), air and water purification, wind and sound filtration or micro climate stabilization (Chiesura, 2004:130). Once the amount of the green space per capita in developed countries abroad is scrutinized, it could be noticed that America has 40m<sup>2</sup>, Amsterdam (Holland) has 45 m<sup>2</sup> to 50m<sup>2</sup>, and Stockholm (Sweden) has 77m<sup>2</sup> green spaces per capita. Yet, in Turkey, according to the Building Code in 3194, Regulation on the Principles of Plan Construction of September 02.09.1999, this rate is 10m<sup>2</sup>/person. However, as the amount of green areas in Turkey is considered, this amount of determined by the regulation is found to be quite low, for instance, 2.3 m<sup>2</sup> in Ankara, 3 m<sup>2</sup> in Isparta, 4.4 m<sup>2</sup> in Antalya, 2.1 m<sup>2</sup> in Istanbul and 2.8 m<sup>2</sup> in İzmir (Manavoğlu and Ortaçşeme, 2007:262; Emür and Onsekiz, 2007:370)

Urban green areas are designated due to several criteria such as human needs, population density, characteristic features of cities, and user density (Şahin ve Barış, 1998:8). These areas offer the cities ecological functions and allow breathable areas for the urbanite. The ecological functions cover oxygen production, cleaning of polluted air by filtration, effect of coolness in summer and effect of windshield in winter, and carbon retention in the atmosphere (Önder ve Polat, 2012:77-80). They vary as active or passive in terms of urban use, and exhibit differences according to their ecological functions, building code or the plan status and the recreational functions they undertake (Emür and Onsekiz, 2007:369-373). Besides the functional characteristics of open-green areas, they are as well aesthetically influential in terms of offering the city an identity and affecting the city aesthetics (Mahmoud and Omar, 2015:36).

These positive effects of urban open-green areas could only be achieved through proper and appropriate urban planning. Designs that are holistic throughout the city and ergonomic with respect to the urban development plan should be included (Sağlık et al., 2015:78). Thus, the urban green areas designed accordingly would be in accordance with the urbanites ergonomically, and would increase the quality of life

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in the whole city by providing comfort for the users. However, it is expected that the landscape design used in urban green areas should be balanced with nature and complementary in terms of architecture. Therefore, several design criteria should be taken into consideration to ensure the appropriate relationship between planted areas and other elements. In addition, plant compositions in landscape architecture constitute the main living material of the design (Robinson, 1992:8). Consequently, the aesthetic and functional aspects of the plants should be correctly applied by the designers in the planting designs in landscape areas. Nevertheless, the sustainability of the landscape is facilitated using planting design criteria (harmony and contrast, balance, emphasis, repetition and variety) in harmony with other (Booth, 1990:112-114).

### 1.1. Ergonomics-Planting design

Planting design is a process that creates functionality and aesthetics within a space when taken into consideration in relation with science, art and design (Robinson, 1992:110-129). The design of urban green areas according to the planting design criteria renders the plant relationship meaningful with other environments they are in.



Figure 1. Plants form (URL, 1)

Aesthetically, they could create the effects of depth, width, unification, neutrality, transparency. In planting design, line, form, texture and color are closely related to each other, since, these design elements are all basic features within a plant, and since, their components would constitute the concept of a group;

- **Line;** it is developed in the horizontal or vertical direction to indicate straight and non-stop movements in the structure resulting from the branching or contour of the plant. While the horizontal lines are effective in giving perspective, the vertical ones are effective in determining the volume (Gültekin, 1994:21-32). The correct lines create a natural impression on humans, while the curved lines create a natural impression because they are close to nature (Eroğlu, 2010:24).



Figure 2. Plants line (URL, 2; URL,3; URL, 4)

- **Form;** refers to the mass of all parts of the plant (stem, branch, leaf). The form also includes the feature that the plant should have not only the silhouette but also the depth and height. In general, each plant has a structure that expresses itself. These are round, conical or pyramidal, pendent branched, diffusive, creeping, scattered. Round shaped plants; is usually used to obtain contrast with vertically developing trees that are circumscribed. Conic or priamidal form plants; It is used in gardening of official institutions in symmetrical and formal designs. When these plants are used together with groups of monotonous horizontally-shaped plants, they create a vitality and emphasis effect. Examples of columns and pyramid shaped plants are; *Populus nigra pyramidalis*, *Taxus baccata*, *Cupressus sempervirens* (Eroğlu, 2010:25-29).



Figure 2. Plants line (URL, 5; URL,6; URL, 7)

• **Tissue**; refers to the surface of the plant that can be seen or felt with the eye. The texture of each plant varies depending on the shape, shell and trunk structure of shoots and branches. The texture of the plant varies according to the seasons. The texture formed during the summer months is different from the texture formed during the winter when the leaves of the plants are laid. For these reasons, summer and winter views of plants should be evaluated and designed. In addition, the textural differences of plants vary according to the distance of view. Darkly perceived plant groups that are not seen from long distances can be perceived more closely (Erbaş, 2003:107-111). While light and transparent tissue plants show large and large space, coarse tissue plants shrink and constrict. When using the same textured plants side-by-side for this reason, impressive appearances can be obtained with contrasting textured groups (Aksoy, 2002:32-52).

• **Color**; it is the structure of plants with different colors, which is the first pitched branches, fruits and flowers. Color is a spatial sense that affects different directions (Erbaş, 2003:115-118). When considering the harmonics of the colors to the surroundings, one of these colors must be dominant against the other. Cold colors (green, blue, purple) should be used in places where depth is to be gained and hot colors (orange, yellow, red) should be used in order to approximate the object to which they are present (Eroğlu, 2010:32).



Figure 3. Plants color (URL, 8; URL,9; URL, 10)

## 2. Material And Method

Atapark, which is considered as one of the city parks of Trabzon, and its surroundings constitute the material of the present study. Atapark in Trabzon is a park that is easily accessible by the residents of the city and provides different possibilities for its users (seating, resting, food and beverage, children playground, etc.). In the immediate surroundings, there exist public and service buildings, theater and library, shopping center and the Tanjant road, which is the main transportation network of Trabzon. The most significant structure within the park is located in the south part, the historically valued Gülbahar Hatun Mosque, and this mosque as well provides a different meaning on the park. Approximately 4 kilometers to the Trabzon city center, the park has a hard surface pavement of 5200 m<sup>2</sup> and an open-green area of 2250 m<sup>2</sup> (Figure 1).

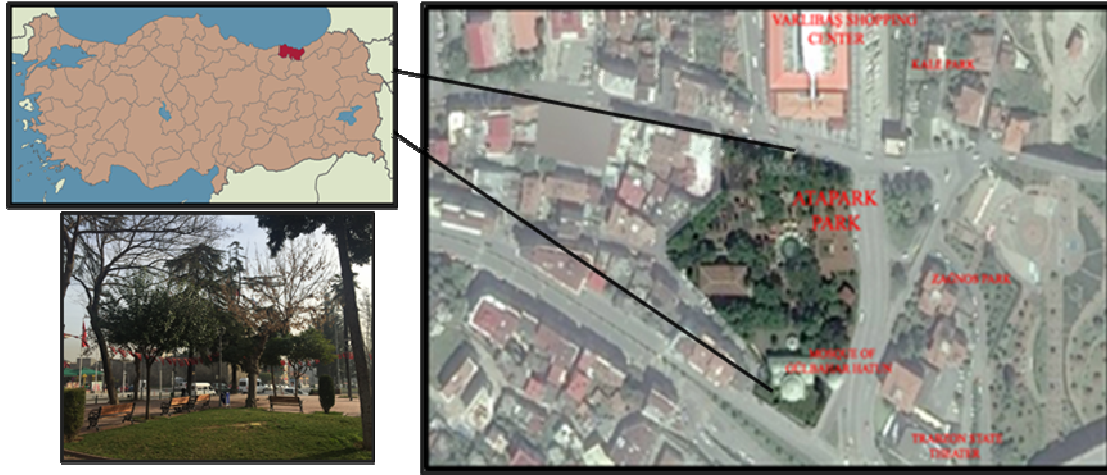


Figure 1. The study area, Atapark

In the present study, data collection, analysis, synthesis and evaluation were used as the landscape research methods. In this context, primarily the plant elements were observed and documented with photography in place. Later, the plants were identified for their positive and negative aspects according to the planting design criteria were, line, form, texture and color. In addition, the plants were evaluated for appropriateness to the anthropometric measures according to their places of use. Within this scope, plants that need care due to excessive branching were identified around the seating areas in the park. Appropriate plant groups in different forms were proposed for different spaces. Thus, the necessary measures that should be taken in terms of planting design in Atapark were specified.


### 3. Results and Discussion

Atapark carried the characteristics of a green area with respect to the surrounding historical and cultural heritage surrounding for years. Therefore, various plant groups exist in the park. There are usually large tree groups in the park, and the varieties of shrubs and especially ground cover plants are scarce. In addition, around the Gülbahar Hatun Mosque in the south of the park, the effect of the centennial trees was emphasized with the large grass surfaces. These plants species are found in park; *Acer negundo* (Akçeşme), *Aesculus hippocastanum* (At kestanesi), *Berberis thunbergii* (Kadın tuzluğu), *Cedrus libani* (Lübnan sediri), *Cercis siliquastrum* (Erguvan), *Euonymus japonica* (Taflan), *Hydrangea macrophylla* (Ortanca), *Lagerstromia indica* (Oya ağacı), *Laurus nobilis* (Akdeniz defnesi), *Ligustrum vulgare* (Kurtbağrı), *Liriodendron tulipifera* (Lale ağacı), *Nerium oleander* (Zakkum), *Phoenix canariensis* (Palmiye), *Pinus pinea* (Fıstık çamı), *Platanus orientalis* (Doğu çınarı), *Prunus cerasifera* 'Atropurpurea' (Kırmızı yapraklı süs eriği), *Prunus serrulata* (Süs kirazı), *Syringa vulgaris* (Leylak), *Rosa spp.* (Gül), *Taxus baccata* (Adi porsuk), *Tilia tomentosa* (Gümüşi ıhlamur), *Viburnum tinus* (Herdem yeşil kartopu), *Yucca filamentosa* (Avize çalısı).




#### 3.1. Ergonomic Condition of Plant Groups in Atapark

Plant groups were selected from the wide green areas in Atapark and their positive and negative aspects were evaluated according to the planting design principles, line, form, texture and color (Table 1).

Table 1. Examination of plants group in Atapark City Park

	<p>In the first space, an emphasis effect on the clock in the park was achieved via the use of symmetrically organized plants. In addition to the symmetrical organization, it was aimed to draw attention to this area through the use of conical form plants and the closure effect was maintained with the ever-green plants. Since the plants have intense textures, the space is perceived closer. In addition, the architectural configuration was supported by providing a focal point in this area through the use of column shaped plant.</p>
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	<p>In the second space, alley-forming plants are used, for instance the trees forming planes with their trunks and branches. This planting design led individuals to a space along a certain axis. The long trees have an irregular sagging form and are always green. Since such group of plants does not have a definite form and a symmetrical structure, they are not suitable for alley formation.</p> <p>They usually have curved branching and trunk structures. They create an effect of comfort and leisure on people.</p>
	<p>The third space is composed of dense vegetation since it is the front part of Gülbahar Hatun Mosque. In order to provide the notion of privacy in this area, ever-green, coarse and fence formed plant groups were used. At the borders of the stairs, plants about 100 to 150 centimeters in height, which are proportional to the height of human, and behind these ever-green, dense branched, large tree groups were placed.</p> <p>Thus, the mosque courtyard could obtain the necessitated sense of privacy and secrecy without blocking visibility through a physical obstacle.</p>
	<p>The non-evergreen trees in the fourth space are aligned in linear axes. The Acer negundo type in this area is very old and has a calligraphic structure, hence, its impression in the area is picturesque. Non-straight and nonlinear branching and trunk structure created the impression of a spontaneous nature in the area.</p> <p>These nonlinear contours create comfort and peacefulness in humans. The ever-green plants in the back create a background effect, and thus cause solid and void effects according to the foliage condition of plants in summer and winter months.</p>

Generally, dense ever-green plant groups were preferred for the planting design of the Atapark urban park. Except the simple and geometric forms, the plant groups within the linear axes were supported by dense and coarse-textured plants, hence the solid-void relation was established. This attitude yielded positive results particularly in winter months. Within the park, long trees and shrubs were used, yet not many plant groups were used in the second dimension. In addition, the park was found to be inadequate in terms of coloration.

Coloration four seasons in outdoor planting design is important visually. Because the user wants to see the environment is flowering every semester. For this reason, the first spring-summer, autumn-winter flowering conditions should be analyzed and designed correctly when planting designs are being created. In addition, all the green shrubs and tree groups should be organized together with coniferous species, especially in the winter months. There isn't balance between the plant groups in the vertical and horizontal directions. The plants were arranged at the time of planting, regardless of the conditions of the young and old. This in turn caused the plants to pass through each other and lose their forms. This fact should be taken into account when plants are psychologically affected by humans in terms of form.

When the general silhouette of the study area is examined, it has been determined that the size and form characteristics of the plants are not taken into consideration. The symbolic form emphasizing entry in the park entrances and the use of plants in the soil will be appropriate. In Karasah and Var (2012:9) studies, it is suggested to use plant species which will emphasize entry in pyramid or round forms instead of scattered and natural looking plants at the entrance of the field. For these areas, plant species such as *Buxus sempervirens* 'Rotundifolia', *Thuja occidentalis* 'Compacta', *Thuja occidentalis* 'Tiny timy', *Taxus baccata* 'Fastigiata', *Chamaecyparis lawsoniana* 'Stricta', *Cupressus sempervirens* 'Pyramidalis aurea'

#### 4. Conclusions

A "green" texture in urban areas would both enhance the social character of the city and its urban image in terms of sustainability and continuity. The green areas create positive outcomes in terms of physiological and psychological aspects via directly affecting the inhabitants of the city. However, plants are meaningful in groups and with design elements, rather than being stand alone. The design elements, namely, line, form, shape and texture, balance and define each other and create a sense of unity. Therefore,



planting design is successful when all the design elements are planned and applied in a coordinated and harmonious manner.

Plants in landscape architecture are considered as a “visual art”. This visual art makes sense only when it is used appropriately. In addition to the natural attractions of plants, they are also considered as design tools in terms of visual and aesthetic viewpoints. In this context, plants create complementary, unifying, emphasizing and back grounding effects in the spaces they exist. The plants, which ascribe different meanings to spaces, influence the quality of life of human life. This is only achieved by well-planned and applied planting designs.

In the present study, conducted to ergonomically evaluate the plants in Atapark, it was observed that plants provided optimum characteristics for optimal a suitable image in line with planting design elements. Due to the strong historical background of the park, most plants had a monumental character and included the natural species of the city. The apparent negative condition in the park is the absence of shrub groups beneath the large and small trees. This particularly becomes more evident as the non-evergreen loses their leaves in winter months. However, the coexistence of different plant groups with different ergonomic characteristics appeased this negative situation in terms of planting design. Especially in summer, seasonal plants could be planted on large grass surfaces to provide variety within the green color.

Plants, different formal configurations of plants and their textural differences and colorations leave different impressions on individuals spiritually. While straight and linear axes create controlled spaces, horizontal axes are peaceful and diagonal axes symbolize energetic mobility. Therefore, planting design should be realized with respect to the users and the function of the space in utilizing different design elements.

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