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The Evaluation of Landscape Equipment Components in Terms of Ergonomics

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ABSTRACT The main principle of the Landscape architecture is to create a physical environment compatible with human beings. All elements (the accessory elements) ergonomic-anthropometric norms should be taken into consideration while evaluating the physical environment. Accessory elements are compatible with the characteristic of human size. Health centers were selected as the study area of the current paper, bearing in mind the idea that accessory elements should be created in accordance. With the demands and needs of the users, neglecting mere aesthetics, to decrease the negative effect of Hospital gardens upon human beings. In this paper, fitted landscape elements at Karadeniz Technical University-Applied Health and Research Center- Farabi Hospital were analyzed in detail, their compatibility with anthropometric dimensions was assessed. It was observed that most of the landscape elements did not meet the extreme conditions, revealing the importance of anthropometry in the discipline of landscape architecture. The elements that are not ergonomically suitable were detected and suggestions were made to solve accompanying problems.

INTRODUCTION

The main goal of landscape architecture endeavors is to develop the environment in a way that it can meet the social, cultural, aesthetic, natural and psychological needs of people living in it so that it becomes more beautiful, healthy, organized and aesthetic, maintain the sustainability, recreational opportunities, land-use activities of these characteristics in the environment (Kurdoglu and Kurdoglu 2010; Muderrisoglu et al. 2013; Sakici 2014). In recent years, the factor that provides the real livability and perceptibility for the intra-city spaces, which are among such environments, is the accessory elements. Accessory elements define, determine the area they are located in, and enable the physical interaction between users and the space and also provides morphological, geological, climatic structures and all kinds of living tissues (Kelkit and Ozel 2004; Bayraktar et al. 2008; Kelkit et al. 2012). As a matter of fact, the science of ergonomics, this deems the human factor as its main philosophy, developed by analyzing the dimensions of mankind (Hendrick 2000; Wilson 2014).

The ratio of Human Factors/Ergonomic (HF/E) is very important engineering system to dealing with people according to their abilities and needs (Demirel et al. 2016). Ergonomics (defined as human factors has a fundamental role in sustainability) socially emerged as a result of the coherence between man and nature, and subsequently has been shaped by the relations of man-instrument-environment and also support the design of systems to enhance human well-being (Dul and Neumann 2009; Patel 2014; Hassal et al. 2015; Siemieniuch et al. 2015; Radjiyev et al. 2015). Ergonomics can protect to function to their environment. And also it can maintain to human social life with 'healthy and safety' (Zink 2014; Arslan and Cinar 2015). It aims at attaining the ultimate productivity by reconciling all the systems that man is surrounded by with all capacities and limits, in terms of psycho physiological and socio cultural measures (Guang and Tian 2014; Wilson 2014). Anthropometry, on the other hand, is the branch of science frequently exploited by ergonomics and based on the measurement of human bodies, which defines the differences across people and groups by mea-

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suring the human body (Panero and Zelnik 1979; Dawal et al. 2015).

Aim of the Paper

In the present paper, measurements of some structural and botanical landscape construction elements located around Trabzon Karadeniz Technical University-Applied Health and Research Center- Farabi Hospital were made by photographing them, with anthropometric dimensions. Suggestions have been made after detecting right and faulty applications of accessory elements as per anthropometric dimensions, and making use of the literature. In this sense, this paper answers have been sought for the following questions;

- Do the landscape elements satisfy with patients in hospital garden?
- Do the landscape elements, which in hospital garden, meet patient in terms of psychological physiological?
- Do the landscape elements appropriate for users (patients, elderly and disabled) according to anthropometric standards?

Landscape Elements - Anthropometry

Landscape elements make essential contributions into increasing the livability of intra-city open green spaces and extending the life spans of users (Coban 2013). They are the components that make the life easier for people within urban texture, enable the interaction among people, and make the environment they are located in more meaningful in terms of functionality and aesthetics, and define and complete the space they are in (Aksu and Demirel 2012). Accessory elements used in urban open spaces must have the required features to meet the needs and demand of users, be coherent with the historical and cultural characteristics of the space, and be durable and resistant to all sorts of damaging forces. Therefore, accessory elements need to be designed compatible with different needs and characteristics of the users of different activity areas. Anthropometry is the branch of science that analyzes the human and dimensions of human body metrically and socially (Kartay and Korkut 2009; Korkmaz 2015). Anthropometry is perceived as an instrument used to attain results, not being a result in itself. There are various studies that have dealt with accessory elements in anthropometric sense (Gulgun and Altug 2006; Yoruk et al. 2006; Gunes and Gulgun 2007; Bulut et al. 2008).

Standards for Landscape Elements

The required standards for landscape elements located in urban spaces are explained in Table 1 according to the studies of Austin et al. (1986), Harris and Dinnes (1998), Neufert (2002), Gulgun and Altug (2006), Bayramoglu and Ozdemir (2010), and Onder et al. (2012).

MATERIAL AND METHODS

Study Area

The material in this paper is the present activity spaces located in and around Trabzon Karadeniz Technical University-Applied Health and Research Center- Farabi Hospital, and the accessory elements of the structural and botanical landscape construction elements contained within these areas. Residing on an area of 65.000 square meters, the hospital is established on a campus, and currently in the service of a large number of patients from Eastern Black Sea Region (Fig. 1). The hospital has been extensively used by many people, including the patients coming from nearby cities, since 1986. The hospital is located besides education and research hospital serves broad masses of the region in Eastern Black Sea. The number of patients admitted to Farabi Hospital with 800 beds is increasing every year. The institution has the emergency service, polyclinics and other health facilities. Besides, the hospital has a very large green space and sea view, through which patients can get away from the depressing environment of illnesses.

Anthropometric dimensions are assessed in accordance with varying activity areas and the activity types taking place. Execution of the activity effects the physical properties (arm length, elbow room, the height of hands and feet) of users, inducing to change on dimensions of fittings elements (leaning place, handles and other holding elements) (Arat 2011). Some human dimensions are presented in Table 2 according to Neufert (2002).

In this paper, it has been identified landscape elements which in study area. The landscape elements were classified as floor elements (pedes-

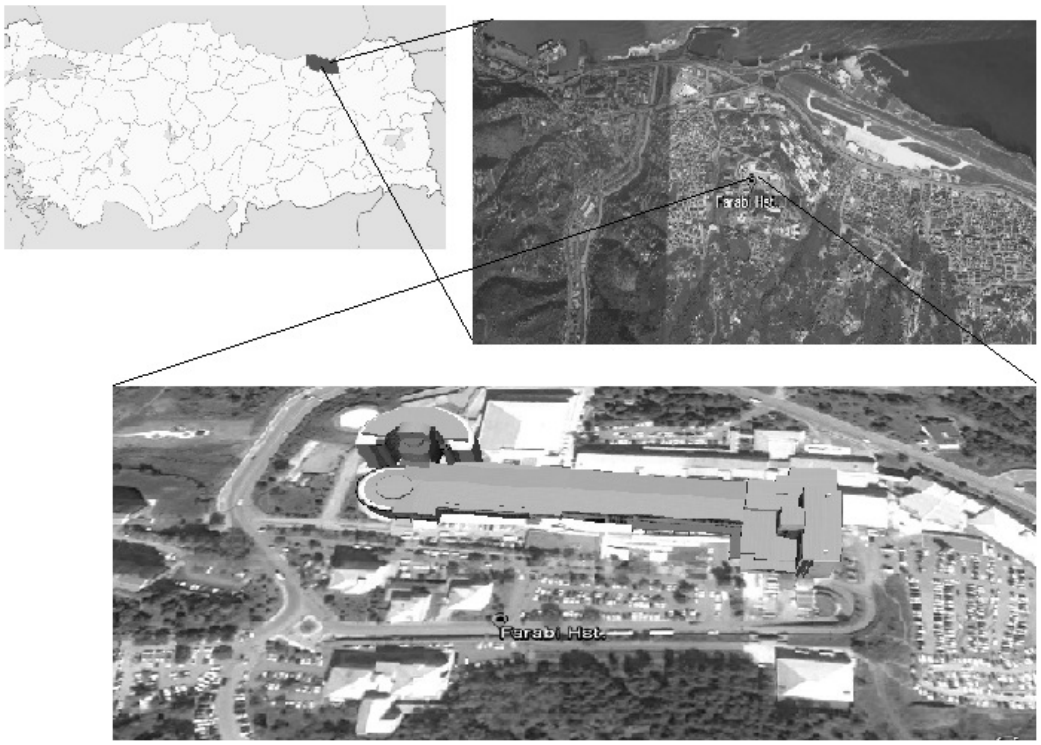

Fig. 1. Location of study area

trian paths, pavements, stairs, ramps and floor tiles), surrounding elements and equipment elements. In the scope of the paper related journals, articles, other academic works, photographs and aerial images were collected, on-site observations were conducted and analyses were made as in Yildizci's (2001) assessments; and the study was conducted through implementing Landscape Research Methods based on the phases of preliminary study, data collection, analysis and synthesis. The data acquired in the study relating the accessory elements located in the study area were evaluated in accordance with the standards depicted in Table 1.

RESULTS

The Determination of Furniture

Equipment elements were identified over the current situation. The current state of the field area is shown in Figure 2. Reinforcement elements examined in this paper according to the anthropometric measurements for each element selected examples are given (Fig. 3).

Floor Elements

As the ground covers used in the study area, Trabzon KTU-Applied Health and Research Center- Farabi Hospital, pedestrian paths, pavements, stairs, ramps and floor tiles were scrutinized. The height of the pedestrian pavements was measured to be ranging from 21 cm to 23 cm. While the rise height is supposed to be around 12-15 cm, the values of pavements here were clearly seen to constrain people (Fig. 3a). While the standard pitch dimension of the stairs should be 15 – 18 cm, the samples were measured to be 21 cm, and the riser height was 25 cm as opposed to the standard of 28 – 30 cm (Fig. 3b). The floor tiles on the pavements and pedestrian pathways are made up of interlocking concrete pavers and they do not hinder the movements of people (Fig. 3c).

Table 1: Standards for landscape elements

Ground elements				
Stairs	*Ramp*	*Sidewalks*	*Pedestrian way*	*Floor elements*
-The width of the stairs should be min.125cm -Height 15-18cm, width 28-30cm (width+2 heigh t=62/64) - Covering material shouldn't be slippery	-Inclination shouldn't be more than 8 % - In ramps more than 10m, inclination should be max. 6 % -Ramps width should be min. 90 cm - Covering material shouldn't be slippery	-Height 12-15cm -Width max. 150cm -Covering material shouldn't be slippery	-Slope should be between 1-3%, some case it may be 5% -Width minimal 150cm and add to 75cm -Covering material shouldn't be s lippery and reflect light	-Reliable and suitable for comfortable walking -Bump height shouldn't be exceed 30cm
Surrounding Elements				
Structural Elements			*Floral elements*	
-Material should be harmony with the environment in terms of texture, color and form. -Height should be low or high to the eye-level. -Structural elements should be height 2cm-2m with stone, brick and concrete, thick 4-8cm and placed on the side of 4-8cm ledge.			-Floral elements shouldn't be more than 180 cm. - In terms of visually texture of the material should be creating the effect of restriction.	
Roof Elements				
-Roof elements are pauses, canopies, awnings, gazebos and consist of regional cover elements. -The height of staff should be 2.5-3.5m -It should be proportionate to the capacity of the space.				
Site furniture				
Outdoor Settle	*Lighting Elements*	*Dustbin*	*Information Signboard*	
-The height of sittings sets from the ground should be 40-50 cm end width 40-50 cm -Should be avoided smooth and texture material, also should have angle of 3-5^0, -Backrest should be support to the lumbar region and should be height -It should be 21.5 to 22.8 cm above the armrest seating surface.	-Height of lighting element should be in pedestrian way; 3-4m, in street; 4.5-6m, in main street; 7.5-9m, in highway; 10-12m. -They should be considered compatible with the environment. -They should be selected according to the environment to statistics found visually.	-They should be positioned according to the functional pedestrian circulation .-Height should be 60-120cm -It should be appear easily.	-It must be such as to overlap each other -It may appear to be a good level of -It must be long-lived and must be easily accessible -Height 210-250 cm.	

Surrounding Elements

The relationship between plant and human is very important in the design of urban open spaces. Because plants are making to create floral compositions make the environmental sense in their environment. Coniferous trees having shape and dimensions which is preventing to walk for users have negative effect (both physically and psychologically) on human beings (Muderrisoglu et al. 2006; Eroglu at al. 2012). In the hospital garden, mostly evergreen species compatible with one another and some bushes that can stay colorful even in winter were used. Plant groups were planted in a way that will direct and guide people generally in the entrance

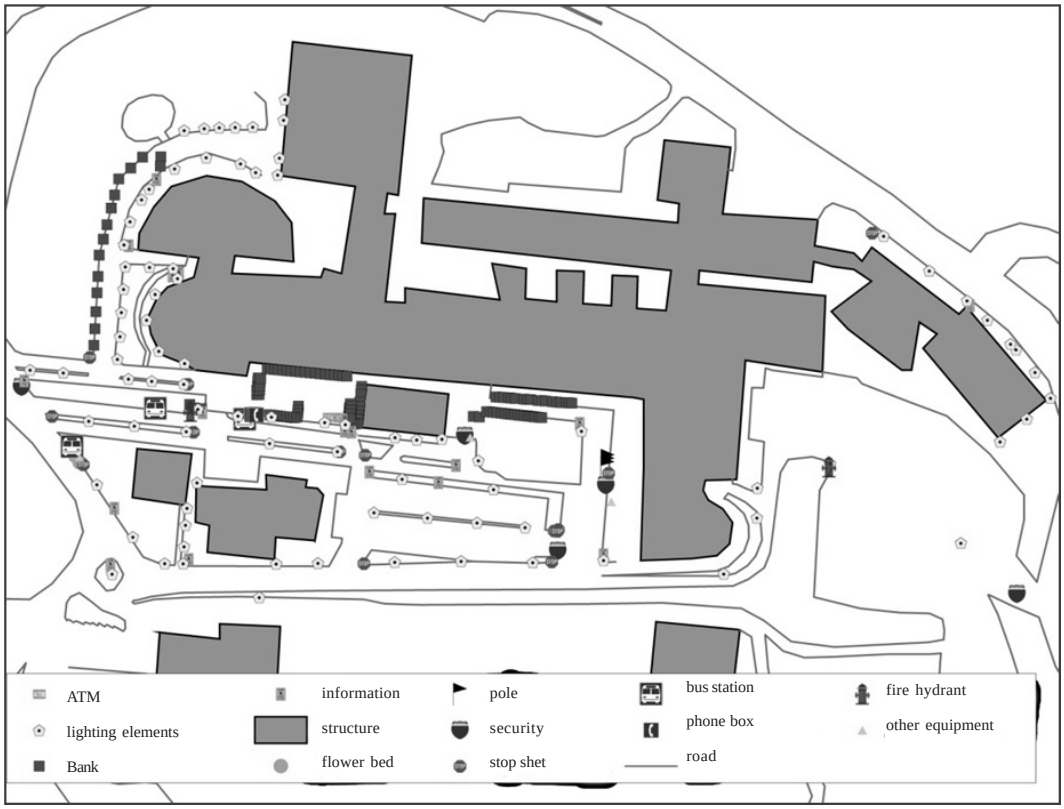

Fig. 2. State of field area

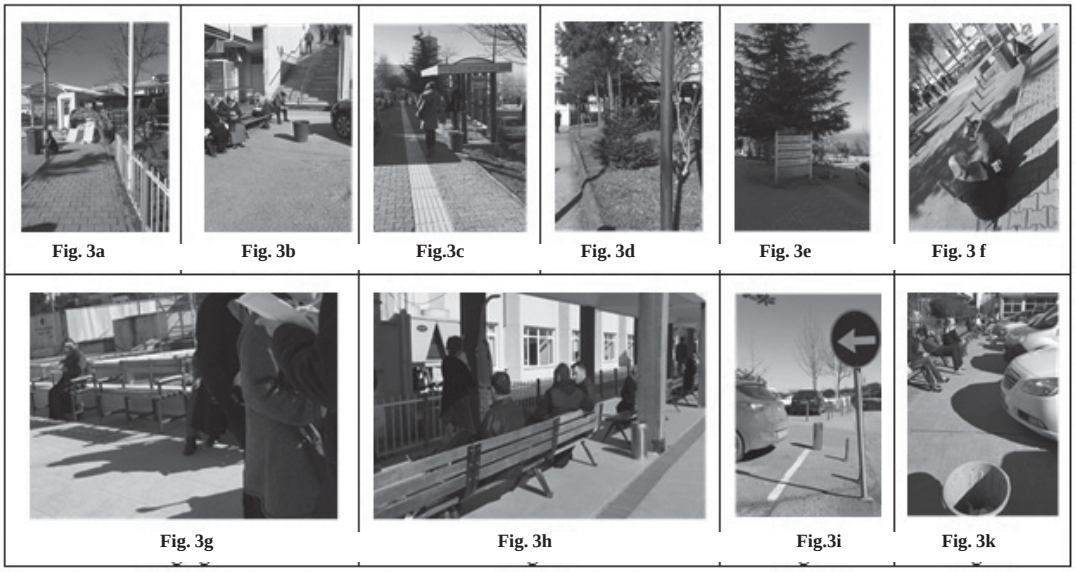

Fig. 3a **Fig. 3b** **Fig.3c** **Fig. 3d** **Fig. 3e** **Fig. 3 f**

Fig. 3g **Fig. 3h** **Fig.3i** **Fig. 3k**

Fig. 3. Landscape elements

and along the pedestrian pathways (Fig. 3d). In the study area, one tree with intensive ramification, where the height of the first branches should have been 1.80 cm, started ramification at 1.65 cm, thus forming a blockage on the pathway (Fig. 3e).

Equipment Elements

Of the accessory elements, sitting elements, lighting elements, waste containers and way signs were examined in the paper. Taking that sitting, resting and lying are the activities most needed by the users of the area (patients), accessory elements are insufficient and located in wrong places (Fig. 3f). On the other hand, placing the sitting elements close to one another enabled socialization among users. It was observed that relatives of patients waiting outside the emergency service and polyclinics, and patients needing to sit and rest have got to sit on hard surfaces.

The benches seen in Figure 3g are made of wood, having a sitting width of 41 cm and sitting height of 50 cm. Taking into consideration the dimensions, as the height is in the maximum level (standard range being 40 – 50 cm), benches can disturb people sitting on them. Besides, being vertical to the ground without any inclination, the backsides of the benches really disrupt comfort. The dimensions of the sitting accessories shown in Figure 3h: sitting with is 40 cm; sitting height is 37 cm and has an inclination of 4^0.

The lighting elements in the area are organized in quadruplets along vehicle roads, and single or double forms on pedestrian pathways. Especially in recent years, lower lighting elements have frequently been employed in illuminating spaces, and the results have been satisfactory. The lighting elements used in pedestrian pathways vary from 320 cm to 400 cm, while road lighting elements range from 530cm to 620cm, being compatible with the ergonomic standards. Road lighting elements are at a sufficient level especially around emergency service, which is extensively used during night time.

Waste containers in the study area are not fixed elements. Their positioning is compatible with the pedestrian walking routes and they are visible. On the other hand, the containers are 70 cm above ground level. In this sense, they are acceptable in terms of the standards (60 cm–120 cm), and the material used is coherent with the environment. Despite being compatible with the

Table 2: Human dimension (woman and man) according to human position

	Human dimension								
	Height	*Width of shoulder*	*Upper leg*	*Width of chest*	*Knee height*	*Sitting elbow height*	*Height of bust*	*Hip-knee length*	*Width of knee*
Woman	Max.179cm	Max.45cm	Max.54cm	Max.55cm	Max.50cm	Max.135cm	Max.91cm	Max.56cm	Max.12m
	Med.166cm	Med.40cm	Med.42cm	Med.50cm	Med.46cm	Med.11cm	Med.83cm	Med.49cm	Med.9cm
	Min.154cm	Min.36cm	Min.38cm	Min.43cm	Min.44cm	Min.9 cm	Min.76cm	Min.50cm	Min.6cm
Man	Max.190cm	Max.57cm	Max.66cm	Max.48cm	Max.51cm	Max.14cm	Max.96cm	Max.48cm	Max.13cm
	Med.177cm	Med.47cm	Med.47cm	Med.40cm	Med.47cm	Med.12cm	Med.83cm	Med.43cm	Med.10cm
	Min.164cm	Min.40cm	Min.43cm	Min.35cm	Min.44cm	Min.9cm	Min.77cm	Min.44cm	Min.7cm

standards, their location is not right at all. Moreover, the waste containers presented in Figure 3i and Figure 3k are not coherent with their surroundings. They are not covered, thus carrying health risks, and they are portable. They have a negative influence on the hospital environment, which is mainly made up of patients and their relatives. The waste containers around the open space canteen are located very close to sitting area, and they are not covered as well.

DISCUSSION

The importance of anthropometry in the discipline of landscape architecture was stressed by approaching the landscape elements in public areas in terms of ergonomics and making use of the ones present in hospital gardens as sample. As portrayed in the samples assessed, some of the landscape elements (floor tiles, surrounding elements, roofs and reinforcement elements) are compatible with anthropometric dimensions and some, on the other hand, are incompatible and dilapidated, posing risks to users. Kartay and Korkut (2009), similarly, assessed the accessory elements in Istanbul in terms of anthropometric dimensions, and detected some designs and applications incompatible with human dimensions, indicating that incompatibility created a risky and unsecure environment for the users. Sakici and Var (2014), on the other hand, indicated the essentiality of the existence of such facilities as physical relaxation, stress reduction, increasing the feeling of well- being, increasing physical mobility, and suitable accessory elements that are positioned towards sceneries in hospital gardens. As Aksu and Demirel (2012) indicated, even though the study area has an opportunity to see a scenic urban view and sea view, the accessory elements are unfortunately not in right places to see them.

As sitting elements directly affect the physical comfort, their material, ergonomics and design are very crucial for users' (especially old and child) comfort (Karakaya and Kiper 2011; Erdogan Onur and Demiroglu 2016). Structural elements used in the area (asphalt, interlocking concrete pavers etc.) are coherent with their surroundings in terms of material, color and texture; however, they are not suitable for a hospital garden. Using natural materials rather than artificial ones, and creating a natural environment enable socialization of users (patients, their relatives and personnel) both physically and psychologically throughout the treatment process (Karakaya and Kiper 2011).

Aksu (2015) and Bozdogan et al. (2015) similarly, stated that floor elements should be done naturally and with easy to walk. Rather than asphalt floor covers, rubber floor covers should be preferred as they are nonslip and renewable. Besides, while variable, rough and textured floors have relatively more positive effect on the patients in terms of feelings, hard, bright colored and shiny surfaces result in the feeling of peace and comfort (Lang 1987).

The sitting elements used in the study area are generic units that can be used anywhere, and they are not suitable for an institution with special users (patients) in terms of both design and ergonomics. The height of the pedestrian pavements was measured to 21cm, riser height was 25 cm. The heights of pavements and risers are found to be similar with the results attained by Kartay and Korkut (2009). Pedestrian pathways and pavements are wide enough to allow a few people to walk side-by-side, ranging from 1.20 m to 1.50 m. Austin et al. (1986), similarly, recorded that the room for two pedestrians to walk side-by-side should be about 110 – 130 cm. Sahin and Savas (2014) also determined the sidewalks could be 140-160cm. Users in the illuminated areas can easily see one another. Signs used in health institutions decrease the crowd and intensity of traffic as they enable patients to find their ways easily without wasting time (Ergenoglu and Aytug 2007). Despite fact that KTU-Applied Health and Research Center- Farabi Hospital is a very crowded place, the signs used around the institution are at a sufficient level.

CONCLUSION

As the objects like accessory elements contained in public spaces are in a continuous interaction with their surroundings, users are closely concerned with them. Human beings desire to feel secure in the environment they live in. In the current paper, using the present situation around the hospital, the users of which are patients, relatives of patients and the personnel of hospital, the importance of anthropometry in the discipline of landscape architecture was stressed by approaching the landscape elements in public areas in terms of ergonomics.

In the observations made in the study area it was resolved that elements used to cover floors - in most cases meet the ergonomic standards in terms of width and height as most of the users are people seeking for medical help; however, in some particular places there are incompatibility problems caused by repair works. Due to continuous and intensive use, some parts of the floor covers are worn, and these problems have been solved with temporary repairs. Apart from that, some sick, old and disabled users experience significant problems, as some of the staircases, pavements and risers are not compatible with the standards in terms of height. Even though there is a track spared for the disabled along the main route, it is discontinued at particular points, thus hindering access for them. It is problem as floor elements with perforated and corrugated materials for users. It should be preferred instead of flat and smooth coverings. The surrounding elements located in and around the hospital garden bear the intended functional and aesthetic effect, and in terms of psychological effect- selection of species (ever blooming, evergreen) and their positioning is also quite successful. However, such plants that arborize low and not pruned regularly hinder pedestrian access. Benches located in the garden, which are among the most intensively and frequently used accessory elements, do not have the same dimensions. The height of benches range from 40 to 50 cm, and heights exceeding 45 cm disturb people sitting on them. The height of the pedestrian pavements was measured 21-23 cm, pitch dimension of the stairs were measured to be 21 cm and the riser height was 25 cm.

RECOMMENDATIONS

The elements used in the open spaces should be designed ergonomically compatible with human activities and they should meet people's physiological and psychological needs. Anthropometrical dimensions may vary depending on the intended activities in the area, functional characteristics of the area, and even the region where they are used. To be able to realize this, human dimensions need to be reflected in the design of these elements. Therefore, anthropometric standards should be identified for each and every country, and different landscape elements should be designed for different types of activities.

Landscape elements used in the outer spaces of the hospitals should have a positive effect on patients and their relatives, and they should physically, psychologically and socially support the patients during the treatment process. While providing a peaceful environment for patients and visitors, hospital gardens should have accessory elements that are designed ergonomically based on aesthetic and functional design principles.

Landscape elements are meant for different needs depending on the area of usage. In this sense, to be able to create suitable and healthy open spaces in Turkey, different occupational disciplines should generate standards and regulations that can be commonly used and enforced. Large-scale research studies should also be conducted in Turkey taking gender, age and regional differences into account. In this way, a common resource that can be used in all the activities, whose focus of design is 'human', can be created.

Sitting elements should be made of soft material and some of them should ergonomically enable lying on them, rather than being merely fixed and uniform benches. They should be positioned towards the scenery that will make users feel psychologically comfortable. Existing sitting elements in rest areas should be located at points away from noise, enabling a peaceful and comfortable rest. Special sitting units with different features (material used, dimensions and design) should be designed for the disabled patients.

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