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Evolution of interior space design criteria on the quality of urban environment: Literature review

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Abstract

Efforts to increase the quality of this environment have been going on since the beginning of the concern for shelter in the history of humanity. The main targets of the user, designers, practitioners, and decision-makers are to carry the quality of life, health, safety, and welfare of individuals and other living things to the next level. Problems have been identified to increase the function and quality of the space, spatial requirements have been determined, and researched, and some design factors have been determined to reach the most appropriate solution. The researchers focused on the proposition that the effectiveness of these factors before and during the design process would increase the quality of the space. However, since research generally focuses on indoor quality, the outdoor quality factors that are part of urban design are not clear. This work, was designed to evaluate the usability of these factors, which were determined and measured especially to deal with the interior, in designs at larger scales (street, neighborhood, city…) and to improve the existing. In designs outside the spatial scale, where almost all factors can be controlled by the relevant stakeholders of the process, the subject is approached through changeable and unchangeable parameters and their balancing. Studies on the factors determined during the process were compiled and their effects on different scales were evaluated as a result of these compilations. As a result of the evaluation, some suggestions were given. In the process of redesigning the space, selecting feasible suggestions, and incorporating them into the creation of the future physical space, using the suggestions as urban rehabilitation tools, and considering these interventions to be flexible and suitable for various factors are of great importance for the psychology of the users.

Keywords: interior design criteria, urban environment, rehabilitation, improvement suggestions

1. Introduction

The concept of architectural design points to very different scales in physical environment design. This concept is associated with many components such as furniture, interior, architectural element, building, roads, streets, landscape.

There is an important relationship between design principles and space quality in space design. Design principles are guidelines that determine the basic features of a space such as aesthetics, order, balance, comfort, and function. Therefore, design principles determine how space is created and organized. Space quality determines the qualities of the space, such as comfort, experience,

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and functionality, that the spaces designed with these design principles provide to the users. Some key points in the relationship between design principles and space quality are shown in Table 1.

Table 1 The relationship between design principles and space quality

Design Principles	Space Quality
It includes elements that shape the aesthetic and visual design of the space, such as color, material, balance, and proportion.	It aims to increase the aesthetic structure and visual appeal of the space.
It ensures that the space is arranged in line with its functional needs and thus usable spaces are designed.	It aims to improve the functionality and usability of a space to provide users with effective and comfortable use.
It determines how to ensure order and balance in the space.	Order and balance achieved through design principles improve the quality of space and emphasize how it relates to the functionality and aesthetics of the space.
With human-oriented design, it ensures that the space is designed in accordance with the needs and comfort level of the users.	It aims to make people feel comfortable and relaxed in the space.
It increases the long-term use and effectiveness of the space by providing flexibility and adaptation.	It aims to enable the space to adapt to changing needs over time.

This relationship between space quality and design principles in space design is in constant interaction from the early design stage of a space to its use. The correct use of design principles meets the needs of users by combining “aesthetics, functionality, usability and comfort”, which increases the quality of the space.

The quality of space environment, which is very important for human health and well-being, depends on factors such as suitable ventilation, fresh air, adequate lighting, and appropriate temperature. People spend most of their time indoors, so the quality of indoor spaces has a direct impact on human health. In addition, spatial conditions are effective on human behavior (Iwashita & Akasaka, 1997; Kasof, 2002; Andersen et al., 2009; Keyvanfar et al., 2014; Deng et al., 2021).

Although physical environmental parameters such as “air temperature, relative humidity, acoustics, air quality, lighting, ventilation and air distribution” are all interrelated, traditional studies on the indoor environment deal with each one separately (Wong et al., 2008). It is necessary to study the combined effects of environmental factors to understand the interactions that cannot be obtained by studies investigating the individual effects of each factor or by studying specific factors alone (Nagano & Horikoshi, 2005). According to various studies on indoor quality, the main factors affecting the quality and comfort of the space are shown in Figure 1.

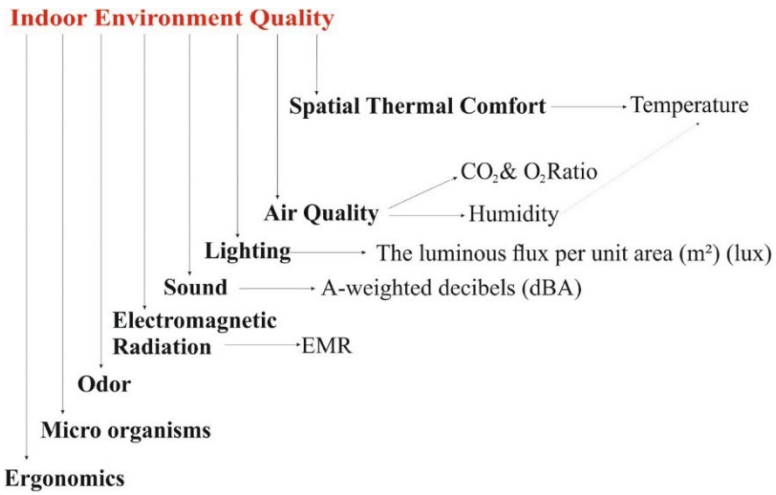


Figure 1 Basic factors affecting the indoor quality (Erkan, 2021)

1.1. Spatial thermal comfort

Energy and thermal comfort are affected by architectural and technical solutions. Therefore, thermal conditions have important effects on design decisions (Attia et al., 2013). Architectural building design parameters (ABPs) determined by designers include features such as indoor air quality, ventilation rate, material properties, building shapes, and building orientation (Rafiq et al., 2003).

Since the perception of comfort is "a psycho-physiological response throughout the cognitive process through thermo-sensitive neurons", thermal temperature, which is one of the physical environmental factors, has a direct effect on people (Erkan, 2020). Thermal conditions in a designated space can reduce "basic aspects of individual human productivity, such as reading, thinking, and doing arithmetic," by 5-15% (Wyon, 1996). It has been observed that when individual employees in Dutch office buildings can control their own thermal environment, their total sick leave due to Sick Building Syndrome (SBS) is 34% lower (Preller et al., 1990). An experimental study conducted in Canadian offices found that workers reporting symptoms of SBS worked 7.2% slower on the Continuous Performance Task ($P<0.001$), a vigilance task in which they had to watch a series of images appearing on a computer screen and respond to someone designated as a target, and made 30% more errors on the Symbol-digit Substitution Task ($P<0.07$), a complex coding task (Nunes et al., 1993).

A passive study of 2150 office workers in Finland found a link between dryness and SBS (Jaakkola et al., 1989). It was determined that dryness and SBS symptoms increased significantly in the air temperature in the range of 20-24 C, and according to the reports of 100 people working in a computerized office at various temperatures applied in this range, thermal conditions had a very significant effect on SBS (Krogstad et al., 1991). Within the scope of the study, each thermal condition was maintained for one week. In the study, when the temperature was at a minimum of 20-21 °C, almost all SBS symptoms increased with temperature, and its effect was observed to be widespread, not limited to only a few sensitive individuals. As a result of the study, the rate of reporting headache and fatigue increased from 10% at 20-21°C to over 60% at 24.5°C, and other SBS symptoms including skin problems showed similar effects.

The findings obtained as a result of the literature review can be listed as follows:

- ✓ Thermal conditions that provide optimum comfort may not provide maximum efficiency. In an experiment that performed mental work at different temperatures (Pepler & Warner 1968), American subjects were most thermally comfortable at 27°C, where they did the least effort and did the least work. Subjects performed most work at 20°C, but most felt uncomfortably cold at that temperature.
- ✓ The effects of heat stress on human efficiency are not always linear. In an experiment (Pepler & Warner 1968) performing mental work at different temperatures, it was concluded that the work rate was minimal at 27°C. However, it will naturally decline below this value in extreme cold or heat. Heat acclimated factory workers residing in South Africa have been shown to perform industrial tasks significantly better at 32°C than at 26°C or 38°C during 8 hours of exposure in normal work clothes (Wyon et al., 1982; Kök et al., 1983). It has also been shown that muscle strength is maximized at moderate cold stress before declining to more extreme levels (Clarke et al., 1958). These nonlinear effects are in marked contrast to the steady decline of comfort above and below the maximum at some neutral temperatures.
- ✓ The critical temperature for performance in temperate regions is about 30°C for normal humidity levels (Pepler, 1964).
- ✓ Accident rates in temperate regions are lowest at 20°C and increase by over 30% below 12°C and above 24°C (Vernon 1936). In addition, it is assumed that accidents increase due to the decrease in human efficiency in adverse working conditions.

Since people spend most of their time indoors, providing the necessary thermal comfort can increase productivity and improve the overall quality of life. Thermal comfort outdoors depends on "sunlight, wind, and the overall design of open spaces," and therefore "trees, shade, and regular use of open spaces" can increase outdoor comfort in hot weather conditions. Urban design elements such as "arrangement between buildings, street widths and building heights" affect the microclimate in the city and determine thermal comfort (Chatzidimitriou & Yannas, 2016; Zheng et al., 2023). Spatial thermal comfort should be considered in overall urban planning as well as in indoor and outdoor design to improve users' quality of life, save energy and generally create a more sustainable and comfortable living space.

1.2. Air quality

By incorporating strategies such as proper ventilation, air filtration, material selection and data analytics, architects and construction professionals can create healthier and more sustainable environments for occupants and the environment.

Outdoor air quality is effective in natural events such as dust storms as well as factors such as vehicle emissions, industrial pollution, forest fires. Outdoor air pollution is an important environmental health problem. Outdoor air pollution causes an estimated 200,000 premature deaths in the United States every year, while worldwide it causes an estimated 4.2 million premature deaths (Environmental Protection Agency, 2022).

Indoor air quality (IAQ) has a significant impact on human health and productivity and plays an important role in maintaining a healthy environment. Indoor air pollution causes an estimated 50,000 premature deaths each year in the United States. Similarly, poor indoor air quality causes various health problems and we can list some of them as follows (Environmental Protection Agency, 2022):

- May trigger asthma symptoms.
- May cause eye, nose, and throat irritation.
- It can lead to more serious health problems such as lung cancer and heart disease.

Indoor air quality is responsible for up to 30% of sick building syndrome (SBS) cases, which include symptoms such as headaches, fatigue, and respiratory problems (Roffael et al., 2019). Exposure to indoor pollutants such as volatile organic compounds (VOCs) can cause respiratory and neurological symptoms as well as cognitive performance (Nazaroff & Weschler, 2019).

One of the most important factors in maintaining indoor air quality is ventilation. Increased ventilation rates can reduce indoor carbon dioxide (CO_2) concentrations and improve cognitive function in office workers (Chen et al., 2017). Similarly, increased ventilation rates provide a 14% improvement in the academic performance of students in the classrooms (Langer et al., 2015). An important factor in ventilation is the air exchange rate (AER), which is the amount of air exchanged between indoor and outdoor environments during a given period. The recommended AER for office buildings is 8-10 liters per person per second (Seppänen et al., 2006).

Another important factor in ventilation is the use of air filters. Installing high efficiency air filters in a building can reduce fine particulate matter (PM2.5) concentrations by up to 40% (Allen et al., 2016). Using portable air cleaners with high efficiency particulate air (HEPA) filters can reduce indoor PM2.5 concentration by up to 60% (Fisk et al., 2019). The use of electrostatic air filters can reduce indoor PM2.5 concentrations up to 80% (Zhang et al., 2018).

In addition to ventilation and air filters, the use of low-emission building materials can also improve indoor air quality. The use of low-emission materials such as paint and carpet can significantly reduce VOC concentrations in buildings (Hodgson et al., 2002).

Measuring indoor air quality can provide important information about indoor air quality and can be used to improve the health and well-being of building occupants. Appropriate measurement

methods should be used to evaluate indoor air quality in buildings. Sensors and air quality indices (AQIs) that provide a numerical score representing the overall air quality in a particular location are commonly used to measure indoor air quality. Wireless sensor network is used to measure various indoor environmental factors such as temperature, humidity, and carbon dioxide levels (Kim et al., 2017). Other methods used to measure indoor air quality include air sampling and personal exposure monitoring. For example, an AQI was used to assess indoor air quality in different building types in China (Wang et al., 2019), while air sampling was used to measure the concentrations of various pollutants, including volatile organic compounds (VOCs) and formaldehyde, in different building types (Kim et al., 2018). Also, the IAQ varies significantly between buildings, and it was concluded that some building materials and ventilation systems have a significant impact on the IAQ (Kim et al., 2018).

In terms of measurement methods, air quality can be monitored using both passive sampling methods such as diffusion samplers and adsorption tubes, and active sampling methods such as personal air samplers and continuous monitoring systems. Passive sampling methods collect contaminants over a period of time, while active sampling methods collect real-time data on pollutant concentrations.

Chen et al. (2018), used a real-time IAQ monitoring and control system with sensors for temperature, relative humidity, carbon dioxide, and total volatile organic compounds (TVOCs) in a commercial building in California to investigate the relationship between IAQ and energy use. Optimizing the ventilation rates of the building according to IAQ conditions can provide an annual average of 15% energy savings and a 26% reduction in peak demand and, in addition, providing real-time IAQ feedback to building users can encourage them to engage in behaviors that can further improve IAQ, such as opening windows or adjusting the thermostat (Chen et al., 2018).

As a result of the study which measuring particulate matter (PM10 and PM2.5), sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and ozone (O_3) concentrations in indoor and outdoor environments of 15 residential buildings in Patna, India, they found a strong correlation between indoor and outdoor concentrations of PM10, PM2.5 and SO_2, while a weak correlation between NO_2 and O_3 (Yadav et al., 2018). It was also concluded that outdoor air quality has a significant impact on indoor air quality in urban areas, especially for PM and SO2 (Yadav et al., 2018). Similarly, data on indoor and outdoor PM2.5 concentrations, temperature and humidity were collected over a two-month period to investigate the effect of building features on outdoor and indoor air quality at a university in Guangzhou, China (Zheng et al., 2018). Within the scope of the study, it was concluded that the dynamic filter effect was positively correlated with the number of floors and negatively correlated with the distance to the nearest road, and the dynamic filter effect was higher during the daytime than at night (Zheng et al., 2018).

Air pollution can cause various health problems indoors and outdoors, have negative effects on the ecosystem, and reduce general social well-being by limiting people's time in open spaces. In urban design, policies such as "transportation planning, placement of green areas and industrial areas" have significant effects on local air pollution levels (Larkin et al., 2016). Improving air quality is important for environmental sustainability as well as improving overall health and quality of life. For these reasons, in urban planning, transportation strategies and environmental policies need to be considered together to protect or improve air quality.

1.3. Lighting

Visual conditions depend on parameters such as “brightness distribution, illumination and homogeneity, glare, color of light, color rendering, flicker rate and amount of daylight” (EN 12464-1, 2002). Daylight, which is a source of illumination, is very important on people's health (Edwards & Torcellini, 2002; Hansen, 2006; Košir et al., 2011; Mirrahimi et al., 2013; Acosta & Figueiro, 2015), sustainability of living resources (Dobrin, 1998; Kim & Kim, 2010; Konis, 2013; Korsavi et al., 2016; Al Zaabi et al., 2017), energy saving (Li & Lam, 2001; Bodart & De Herde, 2002; Galasiu & Veitch, 2006; da Fonseca et al., 2013), productivity and success of people (Leather et al., 1998; Fontoynont,

2002; Park & Athienitis, 2003; Ruck, 2006; Manav, 2007; Krüger & Dorigo, 2008; Winterbottom & Wilkins, 2009; Erlalelitepe et al., 2011; Samani, 2012; Şansal, 2013; Ahadi et al., 2016; Shishegar & Boubekri, 2016). Therefore, daylight is a necessary and useful strategy for providing visual comfort (Fakhari et al., 2021). However, adequate integration of natural and artificial light sources is required to support visual and non-visual requirements in indoor environments (Krüger et al., 2018). Lighting conditions affect human performance with vision, circadian rhythm, and perceptual system (Boyce et al., 2003).

Lighting preference can be affected by individual characteristics such as gender (Chellappa et al., 2017; Huang et al., 2020), age (Boyce, 1973; Knez & Kers, 2000; Park & Farr, 2007; Zhong et al., 2017) and personality (Despenic et al., 2017).

Various studies are carried out to investigate the effect of light on space design. The classification of studies investigating the effect of light on space design and some studies are shown in Table 2.

Table 2 The effect of light on space design

The effect of light on space design	Explanation	Researchers
Investigation of the effect of light on color temperature	It examines how lights of different color temperatures change the atmosphere of the space and how people respond to these changes.	Sinoo et al., 2011; Lan et al., 2021; Li et al., 2021; Jiang et al., 2022; Zeng et al., 2022
Comparison of natural and artificial light	Examines the differences and similarities between natural light sources and artificial light.	Mavromatidis et al., 2014; Al-Ashwal and Hassan, 2018; Chen et al., 2023
The effect of light on the perception of space	It examines the effect of different light levels and qualities on the perception of space. These studies investigate how people perceive spaces, how light affects the appearance of shapes, volumes and textures, and the importance of visual comfort.	Ozorhon and Uraz, 2014; Stokkermans et al., 2018; Hvass et al., 2021
Light management	It explores how light management systems in buildings should be designed. These studies include the placement of light sources, the lighting of indoor and outdoor areas, the design of automatic light sensors and other systems.	Li et al., 2010; Hu, 2017; Dupláková and Flimel, 2017; Edytia et al., 2021
Using Natural Light	Investigates the importance of using natural light in space design. These studies examine how sunlight changes the atmosphere of the space, the effect of natural light on the perception of space, and how natural light helps to save energy.	Baker et al., 2013; Yoon et al., 2016; Wong, 2017; Iommi, 2019; Lee et al., 2022

As a result of the literature review, lighting has various effects on outdoor, indoor, and urban design. Outdoors; It can increase safety and improve visibility, help create an aesthetic atmosphere by highlighting buildings, parks and other areas, and can make a significant contribution to environmental sustainability by saving energy through appropriate lighting design. Indoors; It can improve the comfort of the space and increase the functionality to perform certain tasks, reduce energy costs and reduce environmental impacts, contributing to people improving their mood and increasing work efficiency. In urban design, it can determine the visual hierarchy of buildings, streets, and public spaces, support the night economy, increase the safety of public spaces, and reduce crime rates in areas such as "parks, squares and pedestrian paths".

Considering these various effects of lighting, it is necessary to adopt the right strategies not only in indoor and outdoor design but also in urban design processes.

1.4. Sound

Sound is defined as “a phenomenon that affects our experiences in daily life and helps us define our location and direction” (Aburawis, 2019). Hearing, speaking, and communicating with voice are

among the most distinctive features of human development and culture (Öner, 2021). In addition, hearing is one of the most important ways of survival in living things (especially animals). For example, animal species such as songbirds and frogs use sound and hearing as essential elements of mating rituals or marking areas.

The thermal, lighting, and acoustic design of a space all play an important role on the comfort, performance, and quality of life of the individual (Rozhin, 2022). Influenced by physical, environmental, and social factors, sounds interact and interfere with the connections of listeners and context (Truax, 1996). Sound connects with the quality of life in a place (Bernat, 2016; Bogusz et al., 2011; Hojan et al., 2012). Although sound is an invisible element, it is perceived by the users of the space unconsciously (Nowicka, 2020). Sound in architecture is a feature that affects the space both functionally and aesthetically.

Every sound is unique by nature and emerges once in a vacuum, irreversibly and irreversibly (Öner, 2021). Therefore, each soundscape is region-specific and unique, and it is not possible to capture the exact repetition of the same sound at another time or place. Sound is a form of energy and is created by vibration. The strength of sound is measured in decibels (db).

The term “acoustics”, which deals with the production, control, transmission, reception, and effects of sound, derives from the Greek word “akoustos” and means “heard, heard”. Acoustics, defined as “the science of sound” (Shahryar, 2012), is an environmental variable that significantly affects the human impression of an indoor environment. Acoustic studies have brought the term “acoustic comfort” to the literature. Acoustic comfort can be characterized as (Rasmussen et al., 2010):

- ✓ Absence of unwanted sound
- ✓ Desired sounds with the right level and quality
- ✓ Opportunities for activities without being heard by other people or annoying them.

The acoustic environment is divided into two sub-headings as indoor and outdoor acoustic environments (Brown et al., 2011). Interior spaces have different functional and acoustic properties compared to outdoor spaces (Çakır, 2019). In these interiors, which are surrounded by walls, floors and ceilings, acoustic parameters, especially reverberation time, are considered. Due to the different functions of indoor spaces, the needs and expectations of users differ according to outdoor soundscapes.

Soundscape is an emerging research field first introduced in the 1970s (Schafer, 1970). Soundscape can be summarized as the perception and understanding of an acoustic environment by the individual, group and/or society (Yang & Kang, 2005). This concept is defined as “the field that studies the effects of an auditory scene on the physical responses and behavioral characteristics of its inhabitants” (Truax, 1978).

When sound is taken as the main source for listening and working, it has the feature of making the invisible visible and the intangible accessible. When one hears a place, one hears certain interactions between places, people, and perhaps machines, as well as what they cannot see. Normally the average sound level in the room is used as the indoor sound level or the indoor noise level. Sound can be used as a tool to understand the dynamics, perceptions, and sociopolitical characteristics of the city (Çağlar, 2013). Significant increase in sound level near an open window is a matter of common experience, but even with closed windows sound levels vary considerably within a typical room (Shahryar, 2012).

It has been claimed that the “symbolic sound” (soundmark) for the auditory landscape of the city is the following: the landmark is a derivative of the concept of landmark, which means the sign element associated with the sense of hearing (Öner, 2021). Every building or space has its own sound of intimacy or monumentality, invitation or rejection, hospitality, or hostility (Pallasma, 2007).

The concept of noise is often defined as “unwanted sound”. Many laws and regulations are regulated by noise. There is a very important disconnect between the user’s perception of sound and the planning discipline in the urban space (Öner, 2021). The only approach adopted in many countries is the noise control approach. Required noise reduction (NR) is defined as the difference between the outdoor sound level and the desired indoor sound level (Shahryar, 2012). The main sources of external noise levels are air, road and rail traffic and industrial/commercial activities. The external noise level is the value that can be observed near the outside of the building. There are three types of noise (Schafer, 1977):

1. Unwanted sound
2. Non-musical sound (non-periodic vibration)
3. Any loud noise / disturbance in the signaling system.

Unwanted noise is effective in the emergence of emotional reactions such as anger-irritation in individuals (Schafer, 1969). Noise can also be defined as “as yet unrecognized sound” that has the potential to be redesigned, waiting to be appreciated and evaluated in a new context.

Noise from outside can be reduced in the following ways (Shahryar, 2012):

- ✓ by quietening or removing the source of noise,
- ✓ by attenuating the sound on its path to the receiver,
- ✓ by obstructing the sound path between source and receiver,
- ✓ improving the sound insulation of the building envelope.

Buildings can be evaluated in three aspects, and they are listed as follows (Aburawis, 2019):

- ✓ **Technical performance:** The technical element that can be measured by specific instruments in the building at a particular time.
- ✓ **Behavioral performance:** The behavioral element is related to the occupants’ satisfaction within the sonic environment, which reveals how occupants affected by the context and space design.
- ✓ **Functional performance:** The functional element is concerned with the occupant’s activities in the space, which affect their needs and space design.

To find qualitative feedback of users, positive or negative experiences of sound environment quality are investigated by various objective and subjective data collection methods (Hassanain, 2007). It is thought that the psychological process is understood if a human perception is analyzed in the sound environment (Aburawis, 2019).

Hearing structures the experience and understanding of space (Pallasmaa, 2007). Although sound often provides temporal continuity in which visual impressions are embedded, people are normally unaware of the importance of hearing in spatial experience. For example, when the soundtrack of a movie is removed, the scene loses its plasticity, sense of continuity and liveliness. The most basic auditory experience created by architecture is tranquility. Architecture presents the construction drama muted to matter, space, and light. After all, architecture is the art of petrified silence.

When the place is heard and listened to, it releases its soul, character, and energy to the listener in a holistic sense (Öner, 2021). Each step taken with the act of listening in the space offers the user more data to communicate with the space. Thanks to this three-dimensional sense, it reaches different and many layers in the perception area of the individual and finds its place in different rooms of our memory. Therefore, the layers of sound in the landscape presented to the individual in auditory sense in a particular place can determine that person’s mood and feeling and the soundscape presented in a repeated / similar character and structure in the long run. It also

determines the attitude of the individual towards the place and the quality of the bond she/he establishes with the place.

The effects of the space imposed on the perceived sound in relation to the psychological reflections of the space are referred to as “context effects” (Nilsson & Berglund, 2006). In addition, when people organize sounds in a way that is consistent with the meanings, they attribute to the acoustic signals they hear, it has been observed that the semantic implications of the source are more effective than the physiological characteristics of the sound (Guastavino, 2006). This cognitive process affects the desire, emotional decisions, and spatial orientation of the space user.

Environmental noise outdoors can negatively affect human health and reduce quality of life. In urban design, outdoor noise can be reduced by using solutions such as noise control strategies and green spaces. Sound design in interior spaces significantly affects acoustic comfort. At the same time, keeping noise levels under control can make positive contributions to human health and general productivity. Considering these impacts, sound design should be considered together with various design factors and play an important role in planning processes.

1.5. Electromagnetic Radiation

Electromagnetic fields play "the same or even more important role as the chemical body" (Zang, 2003). Earth's natural electromagnetic fields and all biological systems operate at extremely low frequencies between 1 and 30 Hz. The band up to 300 Hz is designated as extremely low (ELF) and voice frequency (VF) (Mains power in the home is 50 Hz in the UK.) (Saunders, 2003).

The function of the mind and body (endocrine glands and immune system) is controlled by extremely weak electrical brain waves that interact with the electromagnetic environment. For this reason, it is necessary to investigate whether naturally occurring and human-induced electromagnetic fields pose a health hazard. The possible dangerous effects of electromagnetic fields in the home are mentioned more frequently because of exposure to a wide variety of artificially produced electromagnetic radiation caused by systems such as GSM, UMTS, wireless internet via WLAN. Although it is estimated that it may be harmful to health, there is no conclusive evidence.

An overdose of radiation such as solar flares, geopathic stress, or generated electromagnetic fields can produce abnormal biological changes that can disrupt the release of vital endocrine secretions. Exposure to low-frequency electromagnetic fields can reduce melatonin secretions by up to fifty percent (Reiter & Melatonin, 1996).

Each (construction) material has its own electromagnetic properties, such as mechanical and thermal conductivity properties. Electromagnetic properties to consider are permittivity (or dielectric constant), electrical conductivity, and magnetic permeability. These structural features are required to determine reflection and transmission loss from a wall, for example. They are generally frequency dependent. The measurement of these values is usually carried out in anechoic chambers with special measurement setups (Vizi & Vandenbosch, 2016).

It is possible to know the electromagnetic properties of building materials, to dampen from walls and to simulate electromagnetic fields inside all buildings using computer programs.

Providing a healthy indoor environment for building occupants has always been a challenge for designers due to chemical and physical indoor parameters. At present, people's concern is that the body is constantly exposed to radio and television transmitters, mobile base stations, wireless networks, etc. exposure, how radio frequency and microwave radiation affect human health. The radio frequency (RF) spectrum range is from 3 kHz to several hundred GHz. Microwave ranges from 1 GHz to 40 GHz and are used in contemporary point-to-point, wireless and satellite communications. Various studies of non-ionizing radiation such as RFR (Radio Frequency Radiation) levels are being researched all over the world to resolve safe human exposure levels.

Specific guidelines and standards have been issued by the ANSI (American National Standards Institute) /the IEEE (Institute of Electrical and Electronics Engineers), the ICNIRP (International Commission on Non-Ionizing Radiation Protection), the NCRP (National Council on Radiation protection and Measurements) and other organizations. These standards are expressed in power density in mW/cm². For instance, the 1992 ANSI/IEEE exposure standard for the public was set at 1.2 mW/cm² with the antennas operating in the 1800-2000 MHz range (Hakgudener, 2007).

1.6. Odor

Odor in indoor quality can be effective on human behavior. Pleasant odors in the space can significantly improve the mood and performance of the users (Rui et al., 2017). Similarly, outdoor odor quality plays an important role in urban planning and design. For example, creating green spaces provides users with positive emotional experiences (Kim et al., 2016).

Improving indoor air quality has a positive effect on human health, productivity, and comfort. Improving indoor air quality provides a 9-20% increase in cognitive function and a 4-16% increase in productivity (Cheng & Ling, 2019). Improving indoor air quality provides an 8% reduction in sick building syndrome symptoms (Liu & Zhu, 2020). Increasing ventilation rates from 5 L/s per person to 10 L/s per person can reduce the risk of sick building syndrome symptoms and airborne infectious disease by 40-70% (Sundall et al., 2011). "Increasing ventilation rates and reducing concentrations of indoor air pollutants such as PM2.5 and CO_2" results in higher perceived air quality and greater comfort (Jia & Zhai, 2019). Examining the effects on indoor air quality of an office building using the CO_2 level as a representation for indoor air quality, it was concluded that higher CO_2 levels are associated with lower productivity, with a 50% reduction in cognitive scores observed at 1,400 ppm CO_2 levels compared to 550 ppm (Pagilla et al., 2015).

Natural ventilation in spaces can be effective on indoor odor quality. The odor density of the pollutants negatively affects the comfort of the users (Mølhave et al., 1986). Pollutant levels are higher indoors than outdoors, so people who spend most of their time indoors are exposed to more pollutants (Steinemann et al., 2016). In the analysis of odor distribution indoors, it was observed that the levels of pollutants decreased with natural ventilation (Lin & Hwang, 2017). Increasing the air exchange rate from 1.5 to 3 air changes per hour resulted in a 27% reduction in odor complaints (Lee et al., 2019).

Accurate measurement of odor perception is important for sensory evaluations and instrumental analysis, and more objective and sensitive odor quality measurements can be made with the developing technology (Kim et al., 2021). It is used in sensor-based monitoring systems to increase the accuracy and efficiency of odor quality assessments in outdoor environments (Wu et al., 2021). Based on the odor index, an accuracy of up to 95% was obtained with the MLP algorithm in estimating indoor air quality (Chang & Lin, 2020). Also, this method is efficient and cost-effective for monitoring indoor air quality.

1.7. Micro organisms

Indoor environment quality (IEQ) plays an important role, especially for people who spend most of their time indoors. Examining the microorganisms that people interact with indoors and outdoors is very important in terms of the relationship between architecture, biodiversity, and human health (Kembel et al., 2012). Spaces with poor indoor quality can cause many diseases for users (Sadek & Nofal, 2013) and can also affect people's cognitive functions and thus their learning and working performance (Wang et al., 2021). Indoor quality is handled through visual factors other than indoor air quality, thermal environment, lighting, noise, and light (Wang et al., 2021). The presence of microorganisms is generally examined under the heading of indoor air quality.

Humans are exposed to millions of microorganisms every day that can have beneficial or harmful effects (Prussin & Marr, 2015). Microorganisms have a great impact on the comfort level of people in the space. Factors such as "people, pets, plants, sanitary installations, heating, ventilation and air conditioning systems" are seen as sources of microorganisms in the built environment (Prussin

& Marr, 2015). Microorganisms show different effects in different types of spaces and spread depending on different sources. For example, microorganisms that pollute the air with actions such as coughing, talking, laughing, sneezing in hospital buildings (Hiwar et al., 2021) spread due to lack of maintenance such as dusty floors and moldy surfaces in a building such as a school building (Haverinen-Shaughnessy et al., 2015).

While the presence of a small number of microorganisms in the air in the built environment is considered a normal situation, an increase in this amount can become risky (Di Giulio et al., 2010). The increase in the number of microorganisms in indoor spaces is generally associated with temperature, relative humidity, and CO_2 level values (Hiwar et al., 2021). The humidity factor here is considered as one of the most important factors in mold formation (Kubba, 2010). It also has a strong effect on the survival of microorganisms in the air (Hiwar et al., 2021).

Various solution options are available for these factors that adversely affect indoor air quality. The use of plants in hospital interiors improves indoor air quality by reducing the number of microorganisms in the air (Sadek & Nofal, 2013). Similarly, all room areas in the hospital structure should be cleaned regularly (Onmek et al., 2020). The design strategies of space ventilation are of great importance against diseases spread by airborne microorganisms (Kembel et al., 2012).

Microorganisms have decisive effects on health, environmental quality, and overall quality of life in outdoor, indoor, and urban design. The role of urban design on microorganism impact can determine how urban planning contributes to environmental sustainability and public health goals. Therefore, the effect of microorganisms should be taken into consideration in the urban design process.

1.8. Ergonomics

Ergonomics, which is the process of harmonizing the physical environment with humans, is of great importance in architectural design. The important aspects of ergonomics in architectural design are user comfort, safety, accessibility, functionality, sustainability, efficiency, and satisfaction. Therefore, ergonomics ensures that architectural design is user-oriented and allows people to use spaces more efficiently and comfortably.

Since its existence, human beings have needed to consciously and purposefully change and/or rearrange their environment according to their own characteristics. The concept of ergonomics, which is derived from the Greek words “ergos (work)” and “nomos (law)” (Dul & Weerdmeester 2007), is the whole of arrangements and practices made to optimize design, working, and living conditions according to human characteristics (Karwowski, 2000; Güler, 2001). Ergonomics deals with human anatomical features, anthropometric measurements, physiological capacities, and tolerances and examines the basic theories of human-machine-environment compatibility, organic and psychological reactions caused by workplace location and environmental variables (Sabancı, 1989).

Arrangements in the understanding of " suitability for human beings " on the tools and architecture that people will use to facilitate human life form the basis of ergonomics (Duyar, 1995; Dereli et al., 2006). Since the focus is on people, ergonomics considers the physical and psychological abilities and limitations of people. Therefore, factors such as body posture and movements of people, environmental factors, sensory information, and work organization play an important role in ergonomics. These factors have a great impact on the safety, health, comfort, and productivity performances of people in their daily lives (Çobanlar & Koyuncu, 2022). Therefore, we can list the main purpose of ergonomics as follows:

- ✓ To facilitate human life,
- ✓ To provide comfort, health, and safety conditions,
- ✓ Increasing productivity and quality of life.

Ergonomics basically interacts directly with disciplines such as anatomy, physiology, psychology, neurology, engineering, design, behavioral sciences, and management sciences. Designs for human use are expected to meet ergonomic criteria such as functionality, anthropometrics, aesthetics, economy, originality, and compatibility with the physiological and cognitive capacities of users (Akın, 2013). To create a comfortable and safe space, it is necessary to provide the necessary ergonomic standards (Soldatenko et al., 2021). This situation emphasizes the importance of the ergonomics factor in the design of indoor and outdoor spaces.

People spend most of their time indoors and therefore ergonomic control of indoor spaces has a great impact on people's comfort, health, and productivity (Erozan et al., 2023). Although there are similarities in terms of ergonomic control in large, closed areas (such as factories) and small closed areas (such as offices and classrooms), there are also important differences (Erozan et al., 2023). For example, while factors such as noise level, vibration level and dust/smoke level are in the foreground in the indoor environment of the factory building, factors such as temperature and humidity that affect the indoor air quality are in the foreground in the classroom and office environment.

As a result of the literature review, it is seen that the concepts of interior design and ergonomics are mostly discussed together with the factors affecting the quality of the indoor environment at the point of improvement of living spaces and working spaces.

Acoustic environment, ventilation and air-conditioning, thermal environment, visual environment (such as nature scenery), ergonomic conditions and furniture designed spaces have beneficial effects on people (Salonen et al., 2013). For example, the factors that affect the quality of the indoor environment of the library in educational buildings have important effects on the performance of the educational institution and the health and well-being of the users (Lee, 2014). Factors such as lighting, ventilation, thermal level, acoustics, chair and desk ergonomics, room size have effects on learning spaces (López-Chao et al., 2019). An ergonomic indicator for student well-being in educational buildings should be included in sustainability assessment tools (Saraiva et al., 2019). The role of ergonomics in improving the quality of the sustainable built environment (Hedge et al., 2010; Halid et al., 2019) and ergonomic design problems (Hedge & Dorsey, 2013) were investigated. (Hedge, 2013).

There is a consistent correlation between employee productivity and indoor air quality, temperature control, privacy and interaction, and ergonomics (Saraiva et al., 2019). However, while thermal comfort and ergonomic furniture criteria are more important for certain groups, aesthetic and privacy criteria seem to be the least important among some groups (Saraiva et al., 2019).

To improve working environments in terms of ergonomics, it focuses on the control of physical environment parameters (Subramanya, 2022). For example, it should be optimized into the ergonomic design process by understanding the impact of window design on indoor comfort and human behavior (Fusaro & Kang, 2021).

It is of great importance to keep the ambient conditions within optimum limits for people who stay indoors for a long time during the day (Erozan et al., 2023). In addition, fuzzy logic method, which is a thinking and decision-making mechanism that enables making the right decision by digitizing information (Diker & Erkan, 2022a) is used for indoor ergonomic control (Erozan et al., 2023) and to guide indoor scene synthesis (Fu et al., 2020). In addition, fuzzy logic can solve complex problems much faster because it is like human thought and can work with verbal variables (Diker & Erkan, 2022b).

People may have to do some of their work outdoors. In particular, weather and climatic conditions affect people differently. Ergonomics is of great importance in reducing health risks arising from adverse weather and climatic conditions (Soldatenko et al., 2021).

In the pioneering studies discussed, it is seen that public recreation and service areas are frequently examined. Gülgün and Altuğ (2006) discussed the ground texture of the region and the

ergonomic standards of the roof, environment, and furniture elements in the study in which İzmir Promenade was chosen as the application area. In a similar study, Yörük et al. (2006) handled design elements such as stairs, ramps, roads, pavements, flooring, roof elements, lighting elements, dustbins, signboards, and seating elements in landscape designs from an ergonomic point of view. In the study, which deals with the "green ergonomics" approach in public recreation areas, suggestions for various design needs have been created along with ergonomic requirements that will create a pro-nature emphasis (Pavlíková, 2020).

2. Factors increasing the quality of life in urban environment

Cities are complex spaces where people live, work, and interact, and the way these areas are organized holds great importance in terms of sustainability, quality of life, and their impact on people's daily lives (Carmona, 2010). Urban design is a critical discipline that encompasses the planning, development, and improvement of the physical and functional structure of cities. This discipline involves a variety of factors, including street layout, building placement, green spaces, transportation systems, and public areas (Gehl, 2013). Urban design contributes to the creation of livable and attractive cities by ensuring that cities are both aesthetically pleasing and functional (Carr, 1992).

One of the primary goals of urban design is to ensure that cities are designed to the highest standards in terms of sustainability, accessibility, safety, and aesthetics. Sustainability encompasses reducing environmental impacts, enhancing energy efficiency, and preserving green spaces. Accessibility aims to make cities accessible and usable for everyone (Calthorpe, 1993). Safety focuses on making public spaces and streets secure and reducing the risk of crime (Newman, 1973). Aesthetics shape the appearance and identity of cities, contributing to the preservation of cultural and historical values.

The importance of urban design is increasing with each passing day, as cities attract a significant portion of the world's population. Cities are centers that shape people's lifestyles, cultural interactions, and economic opportunities. Therefore, the effective implementation of urban design will contribute to future cities being livable, sustainable, and inclusive.

Urban design directly affects the quality of human life. Lynch (1960) examined how cities are perceived and how people navigate through them. Green spaces, public transportation systems, walkways, and public areas in a city are of critical importance for people to move around comfortably, socialize, and relax, ultimately influencing their quality of life. Cities are complex spaces where people live, work, and interact, and the organization of these areas, their sustainability, and their impact on people's quality of life are of great significance (Jacobs, 1961).

Quality of life is defined as “individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns” (Whoqol Group, 1995).

“Health, participation, in/dependence, communication, personal factors, and environmental factors” affect people's quality of life (Hilari et al., 2015). WHOQOL (World Health Organization Quality of Life) examines the quality of life in 6 areas: "physical domain, psychological domain, level of independence, social relationships, environment, and spirituality/religion/personal beliefs" (Whoqol Group, 1995).

Environmental quality, which is a sub-branch of quality of life, covers objectives such as protecting natural resources, reducing environmental pollution, and preventing harmful effects on human health. Space design has many factors that affect environmental quality. The environmental quality of a place depends on many factors such as air, water, noise, heat, lighting, and green spaces. Ensuring environmental quality is important for a sustainable environment. A sustainable space design can minimize energy consumption without harming the environment by promoting the efficient use of natural resources. Thus, this helps to protect natural resources and contributes to the creation of a more sustainable future, considering the needs of future generations.

Indoor and outdoor are quite different from each other in terms of architecture and design. Indoors are enclosed spaces in buildings or structures and are usually spaces people use to work, live, or rest. For example, indoor areas in buildings such as houses, offices, hotels, hospitals, shopping malls are considered indoor. These spaces are usually closed, limited, and controlled.

On the other hand, outdoor is the name given to open spaces outside buildings and can take place in any environment that can be natural or artificial. These venues can include many different places such as parks, gardens, streets, beaches, alleys, and outdoor activities. Outdoors is open, large, and free and less controlled. In terms of architecture and design, interior design includes various factors such as furnishings, lighting, colors, and materials, while outdoor design includes factors such as landscaping, lighting, outdoor furniture, and structural features.

Interior quality has a significant impact on quality of life and overall well-being. This quality results from the combination of various factors and encompasses several elements of interior design, including lighting, air quality, sound insulation, ergonomics, color selection, material usage, and furniture arrangement, among others. How these factors are achieved at the urban scale forms an integral part of urban design. Urban planning and design processes involve decisions such as building placement, integration of green spaces, design of public spaces, and traffic regulations. For example, in high-density urban areas, building placement and heights can enhance natural light reaching interior spaces. Additionally, reducing traffic noise and increasing green spaces can improve indoor air quality (Jacobs, 1961; Gehl, 2013).

The impact of urban design on interior quality encompasses not only the interiors of buildings but also numerous factors that affect the quality of life for city residents. Therefore, urban design should incorporate numerous positive practices and strategies to enhance interior quality. The effects of urban design on interior quality are an important subject that requires further examination and research, and there is a need for more studies in this area (Lynch, 1960; Carmona, 2010; Gehl, 2013; Lynch, 1981).

It is important to increase environmental quality, as people have needs such as quality air and lighting during the time they spend in places. Indoor air quality can be improved by encouraging the use of natural light, ventilation, and green spaces in a space design process. Both interior design and exterior design are the processes of designing spaces in an aesthetic, functional and useful way. Therefore, a good space design creates an environment in which the users can live comfortably through the correct planning and design of the interior and exterior spaces.

Both interior design, exterior design, and urban design have significant impacts on human health and well-being. For instance, natural elements are effective in reducing the stress levels of those working in interior design (Kaplan, 1993). Nature views are influential in the healing process of patients (Ulrich, 1984), and the natural environment is effective in reducing mental fatigue among individuals. Urban green spaces have positive effects on people's mood and well-being (Dallimer et al., 2011).

Interior design, exterior design, and urban design exhibit significant interaction. These three design disciplines complement each other and work together to enhance the impact and functionality of a city or buildings on the quality of life for their users.

Alexander (1977) argues that interior design, exterior design, and urban design can complement each other and emphasizes the need to consider indoor and outdoor spaces together using patterns. Lynch (1964) examined how cities are perceived and understood by people. Gehl (2013) advocates for a human-centric approach in urban design. He also discusses how urban design impacts economic development and asserts that the creative class is sensitive to the quality of both indoor and outdoor spaces in cities (Florida, 2002).

Interior design, exterior design, and urban design interact with each other and collaborate to enhance the functionality, aesthetics, and quality of life of a city or a structure. The interaction

between these design disciplines can help people better understand their living environment and make design decisions with more informed insights.

To establish interaction between the city and the people, it is necessary to ensure that the environmental conditions in which people live are appropriate, and all factors affecting human health and well-being, including social, political, and environmental health, should be considered (Pacione, 2003). The urban environment is characterized by a high density of built (man-made) elements and infrastructures, high population density, soil and air pollution, noise, low biodiversity and scarcity of natural ecosystems (Olszewska-Guizzo et al., 2021b). These factors constitute the sum of environmental exposures harmful to human well-being and mental health (Tost et al., 2015).

Urban environmental quality is one of the main topics of environmental psychology. Because the quality of settlements is essential for human life. “Noise pollution, environmental pollution, air pollution, crowded and uncomfortable environments, lack of urban infrastructure etc. These conditions” negatively affect the quality of the urban environment and cause “many physical and psychological problems, including health problems, distress, negative thoughts, decreased cognitive function and prosocial behavior”, but “green spaces, forests, education and health areas, appropriate transportation and infrastructure”. opportunities” affect the quality of the urban environment positively (Vural, 2020; Erkan, 2023). Therefore, urban environmental quality is a multidimensional concept that has both positive and negative effects on human well-being and health (Bonnes et al., 2018). Eco-environment quality is the result of many factors such as economy, pollution, climate, and disasters (Talebmorad et al., 2021).

In urban planning, the main purpose is to meet human needs and requirements. Therefore, design quality has some effects on people's desire to use the space (Mohamed & Othman, 2012). Therefore, architects, landscape architects and urban designers design people oriented as spaces have a direct relationship with users, and therefore their designs should prioritize people's health and well-being (Marans, 2012; Shamsuddin et al., 2012; Olszewska et al., 2014; Banaei et al., 2017).

Outdoor design in urban design has many factors that shape the physical environment of a city or residential area and affect users' experiences in open air spaces. In addition to increasing the visual appeal of a residential area, outdoor design can also increase social interaction in the area. It can also help protect environmental factors such as sustainable use of natural resources, protection of green areas, consideration of environmental factors. Outdoor design also considers factors such as physical security and lighting to make outdoor spaces feel more comfortable and secure for users. This can help people use the outdoors more often and thus lead a healthier lifestyle.

To address deficiencies in urban design and outdoor space design, it is necessary to emphasize multiple stakeholder collaboration, increase green spaces, and focus on sustainability and environmentally friendly design in urban planning and outdoor space design.

In urban design, collaborative efforts among various stakeholders are crucial to ensure there are no shortcomings in urban design projects and that they are successful. In this context, there should be more effective communication and collaboration between city residents, municipalities, designers, and local authorities. Azadi (2011) draws a parallel between the definition of collaboration, whether formal or informal, mentioned by Smith (2009), and Hemmati's (2002) concept of a 'multi-stakeholder process.' According to Hemmati (2002):

- ✓ All significant stakeholders should come together for communication and decision-making on a specific issue.
- ✓ Communication among stakeholders should ensure equality and accountability.
- ✓ Three or more stakeholder groups and their opinions should be equally represented.
- ✓ Adherence to democratic transparency and participation principles is essential.
- ✓ The formation of partnerships and strengthened networks among two or more stakeholders is necessary.

It is evident that prioritizing multi-stakeholder collaboration is essential for addressing deficiencies in urban design.

Increasing green spaces in outdoor design can provide more opportunities for outdoor activities and improve environmental quality. Gianfredi et al. (2021) conducted research on the relationship between urban green spaces and health indicators, analyzing the connection between exposure to public urban green spaces and physical activity and mental health outcomes. They have demonstrated the potentially beneficial effects of exposure to public urban green spaces. In this context, there should be a greater focus on how parks, gardens, and green spaces can be designed and sustainably maintained.

Sustainability and Environmentally Friendly Design: Cities are responsible for a significant portion of global CO_2 emissions, and they are particularly at risk due to rapid urbanization and the effects of climate change, leading to the depletion of natural resources and agricultural lands (Ameen et al., 2015). Therefore, it is of paramount importance for urban design to be environmentally friendly and sustainable to conserve natural resources and reduce energy consumption. Sustainable design principles and practices should be increasingly emphasized and prioritized in the field of urban design.

3. Conclusion

As a part of architectural design and urban design, which is one of its biggest components, outdoor design is important for increasing the livability and quality of a residential area. However, outdoor environmental quality factors have not been fully clarified since the researches focus on indoor quality. The main reason for this uncertainty is that different uncontrollable factors affect the design in different geographies during the outdoor design process (Table 3). These factors are political decisions, natural disasters that require urgent structuring, economic conditions, management changes, wars, climatic factors (climate change process) and migrations. Therefore, during the interior design process, it is much less likely to use some of the elements considered before and during the design process, and the like, outdoors. It is possible that some of these factors, which cannot be applied in the design process of the exterior, but are known to increase the quality, can be used to improve the current situation. The quality of outdoor spaces, which develop without intervention, can be improved to a certain extent with interventions at various scales, without waiting for them to complete the structural front. In the areas where improvement will be made, first the problem should be identified, then the relevant intervention should be selected and implemented.

In this context, in residential areas; Increasing and creating green areas (increasing humidity, increasing visual comfort, improving air quality, balancing radiation, etc.), for the same reasons, using more trees on streets, roads and streets in the urban landscape and thus increasing the ecological contribution in the urban area, laws and regulations preparation of regulations, urban furniture, bus stops, ramps, stairs, designing lighting elements in accordance with anthropometric dimensions, increasing sensory surfaces and improving floor coverings, increasing visual comfort, designing / creating semi-open spaces, developing designs that will provide air circulation, mass placement, density Short and long-term improvement interventions can be implemented such as designing the bridge, gauges and their relations, taking into account the prevailing wind direction and sun effect, and directing natural light and radiation in this way, re-handling the traffic, and making vegetative noise curtains (Table 3).

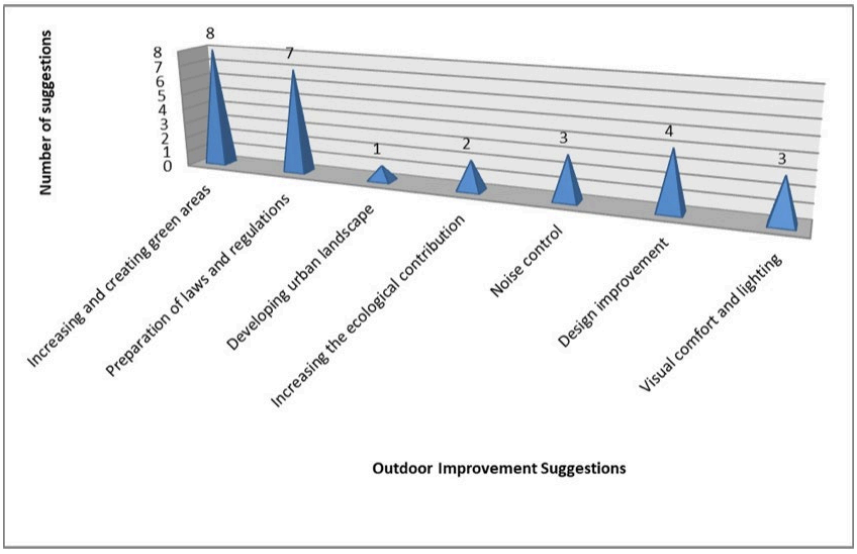
Table 3 Indoor and outdoor improvement suggestion

Design Criteria	Indoor	Outdoor	Outdoor Improvement Suggestions
Air quality	✓	✓	▪ Increasing and creating green areas ▪ Preparation of laws and regulations
Temperature	✓	✓	▪ Increasing and creating green areas ▪ Preparation of laws and regulations
CO2 & O2 ratio	✓	✓	▪ Increasing and creating green spaces ▪ Preparation of laws and regulations ▪ The use of more trees on streets, roads, and streets in the urban landscape ▪ Increasing the ecological contribution in the urban area
Humidity	✓	✓	▪ Increasing and creating green areas ▪ Using more trees on streets, roads, and streets in the urban landscape ▪ Increasing the ecological contribution in the urban area
Lighting	✓	✓	▪ Orientation of natural light and radiation by designing mass placement, density, gauges, and relations by considering the prevailing wind direction and sun effect.
Sound	✓	✓	▪ Traffic restructuring ▪ Making vegetative noise curtains ▪ Construction of noise barriers
Odor	✓	✓	▪ Increasing and creating green spaces ▪ Preparation of laws and regulations. ▪ Following the local government through the establishment of relevant units
Electromagnetic Radiation	✓	✓	▪ Placing and shielding radiation sources as far away from settlement as possible ▪ Laws and regulations, checking with measurements
Micro Organisms	✓	✓	▪ Increasing and creating green areas to increase humidity ▪ Designing by considering the dominant wind direction and sun effect of mass placement, density, gauges, and relations
Ergonomics	✓	✓	▪ Designing bus stops, ramps, stairs, lighting elements in accordance with anthropometric dimensions in urban furniture ▪ Increasing sensory surfaces and improving floor coverings ▪ Increasing and creating green areas ▪ Increasing visual comfort ▪ Design/creation of semi-open spaces ▪ Development of designs that will provide air circulation

To compare the ratios of the factors to be used in improvement, suggestions regarding each other were collected in 7 main groups. They are 'increasing and creating green areas', 'preparation of laws and regulations', 'developing urban landscape', 'increasing the ecological contribution', 'noise control', 'design improvement' and 'visual comfort and lighting'. As seen in Table 4; the rate of 'creation and increase of green areas' shows that this proposal is the most important and effective of the table. Another important group of recommendations is the 'preparation of laws and

regulations'. Since these two proposals affect many factors, their widespread impact in the urban area will also be great. This sequence was continued by 'design improvement' and 'visual comfort and lighting' (Table 4).

Table 4 Suggestion groups



It can be said that the suggestions created in the Table 3-4 can be used in the formation of urban space in two different ways. First, In the process of re-designing the urban space, it is necessary to select the applicable ones among the proposals in question and to consider them in the formation of the physical space of the future. The other is the intervention to be made by seeing these suggestions as a kind of urban rehabilitation tool. This type of intervention can be implemented at different scales and in a way that provides opportunities in different settlements. Therefore, they should be considered as flexible interventions, not rigid and limited. Topographic and geographical features of the area where the rehabilitation will be applied, climatic conditions, economic conditions of the relevant administration and socio-cultural structure of the user should be taken into consideration. Multi-faceted research to be carried out will provide a better result, and because of the improvement of the physical environment of the user, improvements will be seen in their social environment and therefore in their psychology. Because there is an interaction between physical environment conditions and psychology that supports each other.

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Resume

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