ENHANCING THE SONIC URBAN ENVIRONMENT IN HISTORICAL SITES: EL-TAHRIR SQUARE IN EL-MANSHEYA, ALEXANDRIA, EGYPT

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ABSTRACT

To improve the quality of life in cities, a variety of interventions are applied. Noise is a substantial and important sort of pollution that has a negative impact on the urban environment and human health. According to the complaint survey, it ranks second among environmental contamination complaints (conducted by EEAA (Egyptian Environmental Agency Affairs in 2019) [1]. The most significant source of noise in the city is traffic noise. In order to improve the urban sound environment, many physical techniques are being applied, especially in the heritage sites, which are considering the main attraction factors that ensure the economic and tourist life of the cities. Human sensory is affecting the marketing of the heritage site which aims at generating a strong place identity of the place that stems from its landscape. Not only do the physical characteristics enhance the place but also the relation between people and place is the main factor that improves the urban environment. Alexandria is Egypt's second-largest city after Cairo. It is located along the Mediterranean Sea, and El-Tahrir square is considered the oldest square in the city located in El-Mansheya. It is affected by a high level of noise due to the surrounding roads and the different social activities. The purpose of this paper is to clarify the design considerations for the most appropriate physical technique along with historical open spaces, with the goal of improving the quality of life (QOL) and the sonic urban environment specifically. The proposed methodology is focusing on how noise affects human perception and the urban environment. Then it delves into the various physical noise control approaches. The goal of this research is to evaluate the suitable design of a sonic urban environment that fulfils social, environmental, and economic perceptions while maintaining a balanced approach to the noise issue in order to improve QOL in historical sites.

Keywords: noise pollution, sonic urban environment, historical sites, traffic noise, acoustic sustainability, quality of life, noise reduction, acoustical level.

1 INTRODUCTION

The metropolis now accounts for more than half of global pollution [2]. The increased density of people in cities has resulted in an increase in numerous sorts of pollution. Continuation of a rapid population growth reaching 105% growth rate in 2020 that results in overcapacity and stress on the city's infrastructure. According to the latest world polls in 2017, Egypt is the sixth most populous country in the world, according to the WHO. Its population is predicted to be around 100,388 million people, resulting in a rapid increase in various forms of pollution [3]. According to the most recent report of Numbeo, Alexandria is ranked as the world's 10th most polluted city [4]. Noise is one of the major variables in the urban environment that has an impact on people's quality of life. Noise pollution is the second most influential pollutant on people's activities and perceptions, according to the WHO [2]. In Egypt, noise pollution is ranked second among environmental pollutants [1]. Historical sites consider as the main attraction point in the city that influences the site's economy. According to various research, each historical area has its sonic environment that should be preserved. Two types of sound impact the sonic environment, manmade and natural. Traffic noise is a manmade sound that comes from three different sources: roads, rail lines, and airports. The

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highest source in the city of noise comes from the roadways. When the acoustic level reaches 70 decibels, it is considered desirable noise by the WHO. Roadways begin at 70 decibels, which is considered a source of noise [2].

2 SOUNDSCAPE

The research focuses on the study of the soundscape as a part of landscape environment design. The landscape is the art of modifying and arranging the different features in the open spaces, urban spaces, and before urban spaces. The soundscape is influenced by the acoustical level in the outdoor spaces. Sound within the urban environment may be generating by two sound sources, natural or manmade. Natural acoustics constitutes the sound that is produced by the natural sources in the natural soundscape, such as the sounds of any living organism [5]. Human-made acoustics are sounds generated from human activities. They include sounds generated from road traffic or sounds generated from human activities [6]. The high complexity of sound in the urban space can be attractive, enjoyable for some people, and not attractive for others, so an urban planner should respect those people who do not find the high complexity of sound attractive shown in Fig. 1 [7].

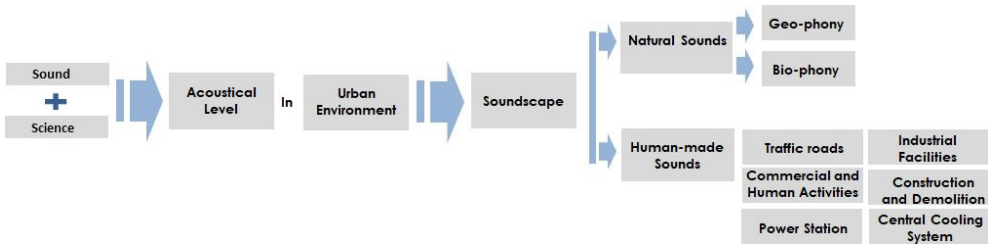

Figure 1: Soundscape sequence.

2.1 Noise and the urban environment

Sound is a means of communication, manufacturing tool, and noise [8]. Once sound starts to disturb humans and their responses, it has become an undesirable sound; therefore, it is considered a noise source [9]. There are different ways to redirect noise when we talk about controlling noise. It can be, in the path between the source and the listener, or the listener himself as shown in Fig. 2 [9]. Urban planners and designers always seek to control noise within the urban space in order to reach their aim at reducing the decibel level in the surrounding urban environment, preserve the identity of the sonic environment in each place and enhance the QOL [10]. Noise adversely affects development because of its direct and indirect harmful impact on society, life activities, public health, and human response. Thus, the development of a national plan for combating noise was mandatory, with the participation of all concerned ministries in the city, according to Cabinet directives. The plan comprised recognizing roles and duties of each ministry in light of the MSEA's (Ministry of State for Environmental Affairs, Egypt) strategy to mobilize efforts to face one of the most hazardous pollutants and identifying scientific solutions to combat it [11].

3 NOISE CONTROL PHYSICAL TECHNIQUES AND STRATEGY IN HISTORICAL SITES

There are four physical techniques to control noise pollution as shown in Fig. 2. The planning phase and the existing phase are the two relevant stages to divide these segments into. First;

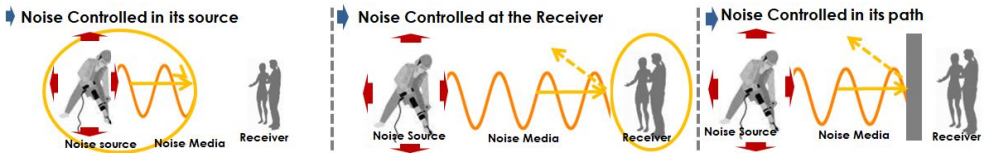

Figure 2: Noise control techniques. *(Source: Hill and Morrison [23], edited by the author.)*

acoustical site design is appropriate and starts in the planning phase of the site. That uses the arrangement of land use on a tract of land to minimize noise impacts. Acoustical site design starts with site planning. This stage control noise from its source.

Second, the acoustical architectural design is appropriate for the existing roadways in the architecture design phase. It incorporates noise reducing concepts in the details of individual buildings in the architecture phase. This stage controls the noise in the receiver. Third, in the construction phase, acoustical construction is ideal for existing streets. It entails the use of noise-reducing materials and procedures in the construction of buildings and sites. This stage regulates the receiver's noise. Fourth, between noise sources and noise-sensitive areas, noise barriers that are applied at the local level and the current situation can be erected. It manages the noise along its path [12]. Historical sites are divided into three types designed, Evolved and associative landscape. The designed landscape is clearly defined and created intentionally by man. The evolved landscape results from an initial social, economic, administrative and/or religious imperative, and has developed its present form by association with, and in response to, its natural environment. Associative landscape the inclusion of such landscapes on UNESCO's World Heritage List is justifiable by virtue of the powerful religious, artistic, or cultural associations of the natural element, rather than material cultural evidence, which may be insignificant or even absent [13]. According to the physical attributes of the historical sites, acoustical construction and noise barriers is suitable in the designed landscape, and Noise barriers are the only suitable in the evolved landscape all shown in Fig. 3. This paper is focusing on the designed history landscape.

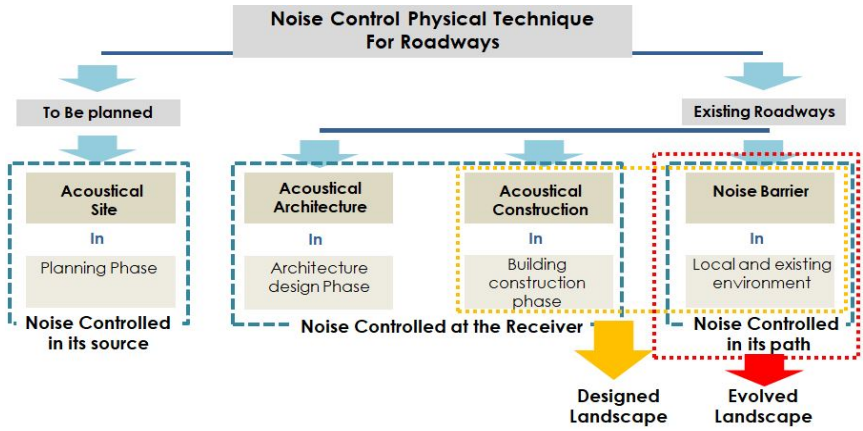

Figure 3: The noise control physical technique and stages. *(Source: [12], edited by the author.)*

The soundscape approach can be an effective way to create quiet zones that take into account not just the numerical limits of regulation, but also the acoustic comfort of the space. As indicated in Fig. 4, achieving sustainability is critical to improving one's quality of life. The question is how to prepare for noise reduction through sound design employing attention and/or acoustic masking in terms of the soundscape. The following methods can be used to reduce noise: (Planting: green walls, green roofs, green ground; Materials: using different acoustical materials; Water structure: The background of city noise is masked by the water structure; Noise barriers) [14], [15].

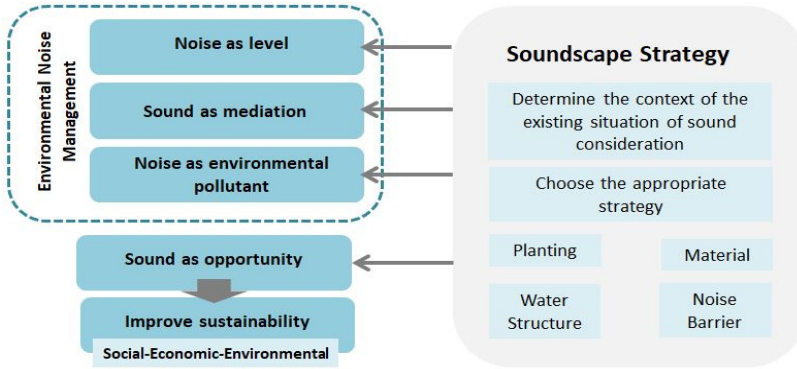

Figure 4: The soundscape design strategy [16].

In order to analyse the existing tool, there is different assessment tools should be considered along the planning process. The measurement, site survey, and questionnaire consider as the three main assessment tools that should be used in order to achieve a successful design. In conclusion, these guidelines, strategies, and assessment tools present a sound level which is a significant impact on human health and/or wellbeing is to be expected. When multiple adverse health effects are identified for a given environment, the guideline values are set at the level of the lowest adverse health effect.

4 SOUNDSCAPE IN HISTORICAL URBAN SPACE

The preservation of historic urban space is dominated by planning professionals with a predisposition toward the broad mandate of constructed heritage conservation; other professions that play an active role in the protection of spatial aspects of the historic townscape are the exception. Urban historians must carefully evaluate the motives of the numerous persons who shape urban form and document urban development when examining various materials. Soundscape has lately been identified as one of the aspects that influence the identity of historical locations. It has also played a significant role in the evolution of our cities and it is an essential component of the urban form.

Urban squares are open public places that represent a city's identity as well as the cultural heritage of its residents. Since ancient times, they have been places where members of the community congregate and "urban life" takes place. Urban squares, as a basic component of the city structure, contribute to the city's image and prestige. The major distinction between a public park and a public square, according to Levy [24], is that "on a square, citizens are not connected to manifestations of nature, but to the heart of urban culture, history, and memory" [17]. Due to changes in public space use over the previous few decades, many

urban squares have lost their function and importance. As a result, creating urban squares as both public and open areas requires greater thought and effort.

In summary, the following are some basic design principles for urban squares [14], [15]:

- To create identity, sense of place and contribute to the overall city image;
- To promote public use and participation;
- To encourage social activities, communication, and social integration;
- To enhance the character of the environment;
- To create a public square that is legible, enjoyable, and long-lasting;
- To create both physically and socially accessible environments;
- To achieve environmental sustainability and low-cost maintenance through environmentally friendly design strategies;
- To promote art, cultural activities, and entertainment;
- To mitigate the impact of noise and enhance natural sounds.

People associate symbolic value with urban public squares, which are more than just physical areas. Sound is seen as a major phenomenon that shapes space and enhances a location's personality. This research shall investigate whether people's perception of the sounds in the respective heritage also reflects these differences. This is very important in order to understand the importance of sounds in preserving the authenticity of a historical place and to protect it from deterioration, similar to protecting a historical place from architectural or other changes. In total, the perception of a sound environment and can be understood as the auditory equivalence to the visual "landscape" and in an attractive way, it is rich the touristic vibes in the archaeological areas. The term soundscape denotes a sonic environment, formed within a context, as it is understood and perceived by people [18].

5 SOUNDSCAPE DESIGN DECISION MAKING

Any successful design decision making is created to achieve the goals for which it was envisaged. These goals may differ for similar design problems. As in historical sites when noise is extreme, the recession of the noise becomes a must in the design goal. Architectural and landscape architecture adapt the acoustical design, control, and analysis in the existing, new buildings and outdoor spaces. Architects may be involved in some acoustical services that can be categorized into one or more, as control of the noise and light from transportation systems, control of the noise and light related to building systems, Seismic, and vibration control, In addition, they are not involved in material and product testing, measurement, and reporting, enhancement of sound, light and electronic reinforcement [19].

The decision-making process of the landscape is divided into the planning processes and design considerations as shown in Fig. 5. These considerations should be well designed and attractive with great care and attention to detail, in order to reach a successful soundscape design [14]. Most of the design consideration along historical is an intrusion into the environment, blending neither with the landscape nor with the surrounding historical buildings for which they were built. Well typically a basic design, is squeezed, stretched, compressed, elongated, shortened and heightened, to fit the space and to realize the coveted shape and material of light and sound landscape elements. Once placed in the landscape it's viewed as a part of the environment. The landscape features and considerations such as this seem visually oppressive, out of place, and over dominant. Whereabouts in the design process, every significance should be adequate in the design to reach a high level of a suitable nightscape design in the ecology and the community in heritage sites [14], [20]. In all cases, the material, height, form, placing, colour, pattern, and visual impact are the design guides

lines Architects should consider these issues in the preliminary design stages to fit the site importance.

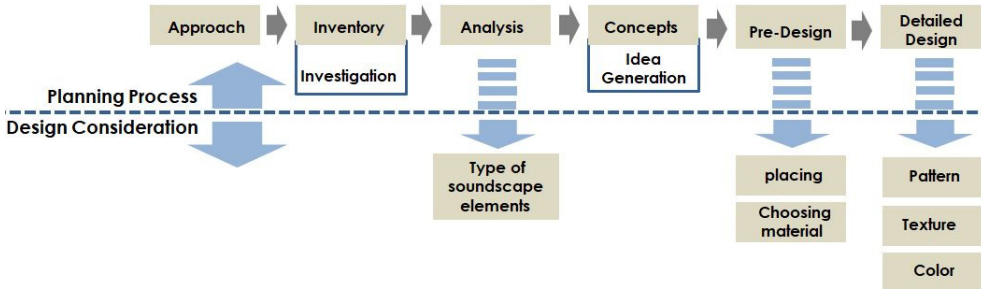

Figure 5: The sustainable planning process sequence. *(Source: [14] edited by the author.)*

In order to achieve a high level of successful soundscape in heritage sites, the approach stage combines the different assistance in the design [14]. Then it is followed by, the inventory step which is a visual analysis of the proposed site and the links that exist between the community, neighbourhood, and geographical area that are crucial steps in the process. The inventory stage can be divided into two attributes; physical and activity attributes.

The analysis stage is the part of the design process when the team's methodology can be used to review and analyse information gathered during the inventory phase. The goal is to distinguish between the community's and the local environment's design, planning, and environmental needs in connection to the proposed noise mitigation project. The concept stage is then dictated by the abstract ideas that emerge from the inventory and analysis of the current state [14], [19]. Furthermore, this step is specified by future needs and qualifications imposed by nearby human activities, site, and highway functions. After that, the concept and assessment development should be followed by the pre-design stage. It should also make use of the ideas and needs established during the creation of an appropriate preparatory design. The noise barrier must be structurally sound, motorist-friendly, long-lasting, acoustically effective, and visually appealing. Basic visual needs, location requirements, and transdisciplinary design criteria should all be considered in the design. At this point, the barrier's position, material, design configuration, and decisions should be decided. Finally, the detailed design is responsible for bringing the design concepts to life. Landscape architects and architects should offer materials, colours, textures, and grading features at this point in the design process. The goal of an appropriate noise barrier design is to use visual design concepts to lessen the visual impact. [14], [19], [20].

6 CASE STUDY (EL-TAHRIR SQUARE, ELMANSHEYA, ALEXANDRIA, EGYPT)

Alexandria is Egypt's second-largest city. It is a seaside city on the Mediterranean Sea that stretches 32 km along the coast in the country's north central direction. It is a major economic centre in Egypt that is known for its high levels of traffic noise [1]. The city of Alexandria has a population of about 4 million people, which, along with the rapid development of annual traffic and the flaws in new buildings, results in increased noise pollution [2]. After garbage disposal, water pollution, unclean and messy pollution, noise pollution is the fourth source of pollution in Alexandria [4]. El-Mansheya Square (El-Tahrir Square) consider as one of the oldest historical squares in Alexandria, which is surrounded by up to 14 historical

listed buildings. The square is affected by the adjacent traffic follow and different commercial activities through the day and night which affect the QOL with sound pollution along the square.

6.1 Inventory

As shown in Fig. 6, Alexandria has three main squares, which are all located within a historical context. El-Shohada Square, El-Tahrir Square, and Saad Zagloul Square are all surrounded by historic buildings. These squares are considered as one of the most appealing destinations for locals and visitors alike. People believe walking and sitting in the squares to be one of the most motivating ways to relax [4]. El-Mansheya square was chosen as a case study zone as El-Shohad square is under renovation and Saad Zagloulis more acoustic pleasant than El-Mansheya.

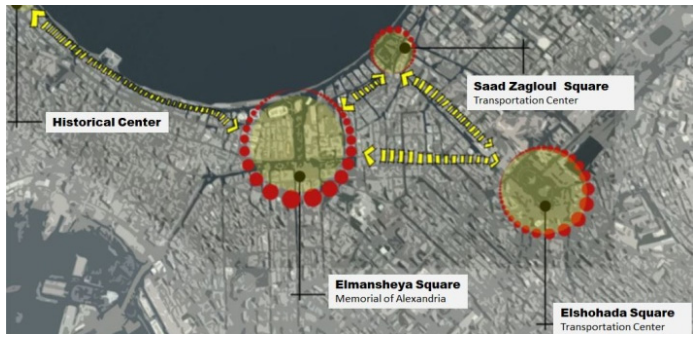

Figure 6: Alexandria squares. *(Source: [21] edited by the author.)*

The inventory step will be analysed according to site surveying of the physical attributes and activity attributes that influence the site.

6.2 Physical attributes

Different Aspects influence the site which is the width of the sidewalk where the different social activities as restaurants, shopping and street vendors, the width of the street where the source of traffic noise, the square width were different social activities, sitting area, picnics, etc. and the surrounding buildings feature shown in Fig. 7.

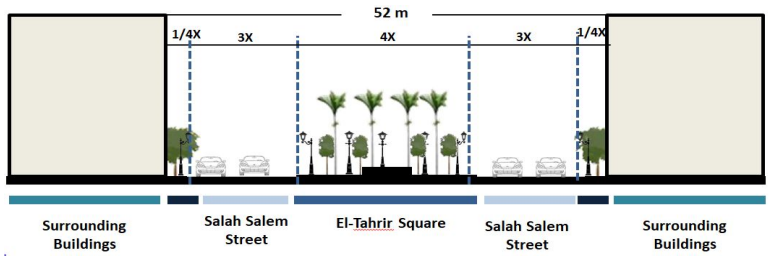

Figure 7: Physical attributes surrounding the site.

6.3 Social attributes

The site is surrounded by different activities day and night. The site is the CBD (Central Business District) and the government interest of Alexandria. As illustrated in Fig. 8, two forms of acoustics dominate the sound quality of the site: human-made acoustics and natural acoustics. Human-made acoustics are divided into two categories. The first source of traffic noise is congestion along the road, which is created by cars horns, tire friction with the tarmac, car motors, and the deflection of cars' speed on the buildings. Second, there are social activities such as social gatherings, sitting in cafeterias, and social contact that takes place around the plaza. Approximately 70% of the users are pedestrians and 30% vehicles there are two main congestion points at the intersection between Ahmed Orabi Street and Salah Salam Street. As well the intersection is between El-Sabaa Banat Street and Salah Salam Street is shown in Fig. 9. Natural acoustics are divided into two categories: wind sound and animal sound. There is also a lack of biodiversity due to the bad urban environment. Human made acoustics are always considered as unwanted sound at the variance of the natural acoustics that has a positive effect on humans psychologically.

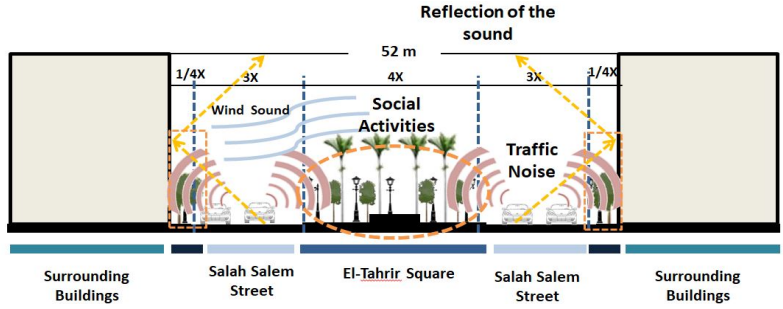

Figure 8: Activity attributes: Acoustics around the promenade.

Figure 9: The traffic and pedestrians flow on the site.

6.4 Analysis

The initial step in the analysis stage is to measure the sound level in and around the square. It was shot at various times, in various zones, and from diverse locations. The sound level meter was used to measure the experiment. Fig. 10 shows the measurements gathered at ten different spots. The measurements were taken on weekdays and weekends, at various times throughout the day, as shown in Tables 1 and 2.

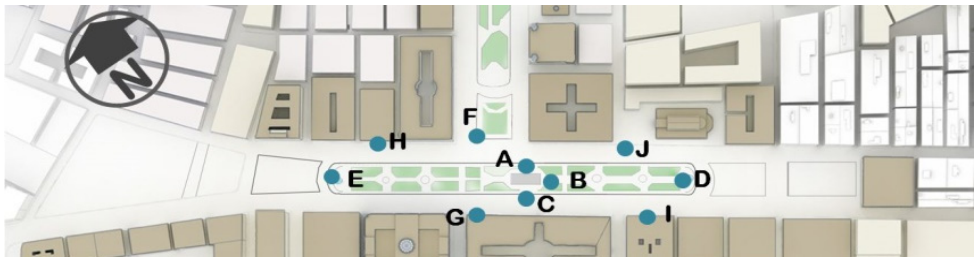

Figure 10: The measurements points.

The average sound level in and around the square on weekdays ranged from 84 to 71 decibels, and on weekends from 81 to 67 which is higher than the acceptable sound level and needs to be improved in order to improve the sonic urban environment [1]. The traffic noise map depicts the impact of traffic noise on the square as shown in Fig. 11.

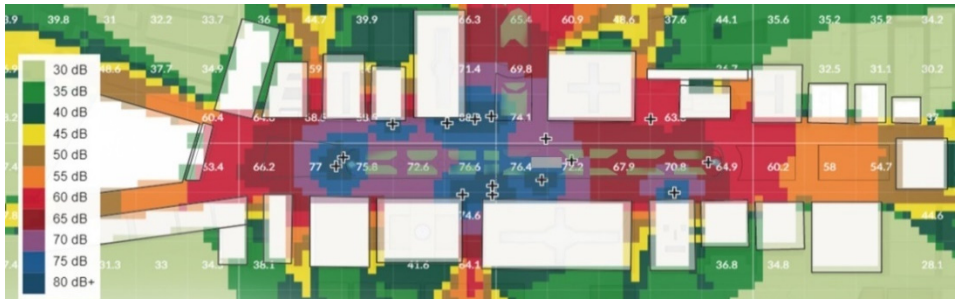

Figure 11: Noise mapping of sporting promenade. *(Source: [22], edited by the author.)*

The previous analysis clarifies that El-Tahrir square is affected by a high level of noise that disturbs the users throughout the site and the history of the site. In order to develop the surrounding sonic urban environment in the site different design considerations should be mentioned:

- Soundscape strategy should be applied in the renovation methodology
- The soundscape construction and noise barrier has been identified as the most appropriate physical technique as the site is considered a designed historical landscape
- Soundscape elements should be applied with appropriate design considerations that integrate with the site context and existing features to support its ability to be a part of the historical context without compromising any of the site's constraints,
- To reduce noise, soundscape elements and noise barriers with appropriately sized apertures for individuals arriving at the site should be installed surrounding the edges, especially in traffic jam points. It should be designed in a Roman style to match Alexandria and El-Mansheya's historical architectural style.
- It is recommended to do a questionnaire assessment in order to measure the user sonic satisfaction along with the site during the analysis step.
- To improve the natural, integrate the soundscape elements and noise barrier with various landscape components and plants,

Table 1: Measurement of sound level in El-Tahrir square in Weekdays in March 2021.

Time		A		B		C		D		E		F		G		H		I		J	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Morning	8:00	71	64	66	60	68	62	65	60	69	64	74	71	75	71	74	71	69	64	69	64
	10:00	72	67	68	63	70	65	67	63	70	66	75	72	77	73	76	73	71	66	70	67
	12:00	81	72	73	64	75	71	71	66	81	73	81	75	83	75	83	75	81	72	80	72
	14:00	82	74	74	66	78	73	73	68	80	75	81	76	84	76	83	75	80	73	81	73
	16:00	81	74	74	65	76	72	72	67	80	74	80	75	83	75	84	75	80	73	81	74
Evening	18:00	80	72	76	66	78	71	76	65	83	74	85	75	84	75	85	77	78	67	79	71
	20:00	84	76	77	67	79	71	78	67	84	75	87	77	85	77	86	75	75	66	80	74
Night	22:00	84	76	75	69	83	74	73	66	82	78	88	82	86	80	85	81	78	70	83	77
	00:00	72	66	70	60	71	64	70	59	73	65	74	66	75	67	74	68	70	65	74	67

Table 2: Measurement of sound level in El-Tahrir square in Weekends in March 2021.

Time		A		B		C		D		E		F		G		H		I		J	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Morning	8:00	67	62	66	60	68	62	65	60	67	62	67	71	69	61	72	61	64	60	64	59
	10:00	68	65	68	63	70	65	67	63	68	65	69	72	71	62	73	64	67	61	66	60
	12:00	72	65	70	64	75	71	71	66	74	70	80	75	71	65	76	70	72	65	70	64
	14:00	75	68	73	66	76	73	73	68	76	72	82	76	84	76	78	72	78	72	76	69
	16:00	76	70	74	65	76	72	72	67	79	74	83	75	83	75	81	75	78	72	77	69
Evening	18:00	80	72	75	66	77	71	76	65	83	74	85	75	84	75	85	77	78	67	79	71
	20:00	82	74	76	67	78	71	77	67	84	75	86	77	85	77	86	75	75	66	80	74
Night	22:00	83	75	76	67	80	74	73	66	82	78	87	82	86	80	85	81	78	70	83	77
	00:00	74	66	70	60	71	64	70	59	73	65	74	66	75	67	74	68	70	65	74	67

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- Many retail shops for trading produce a lot of noise, the choice of durable, self-sufficient, and low-maintenance material is recommended.,
- Street vendors should be controlled on the site as they are a source of noise
- The adoption of higher, denser evergreen vegetation that lures birds towards the city centre should help to lessen noise. As well as a substantial wall overrun with climbers, there is a lack of biodiversity along with the site. On the front, this should be required. At the end of the analysis, it goes to some recommendations in order to improve the 3 pillars of sustainability according to the framework.

7 CONCLUSION

The impact of noise pollution on quality of life is discussed in this paper. Many scientists and planners agree that soundscape should be included as part of the planning process in order to incorporate the positive aspects of sound into the urban environment. According to the planning process and design consideration technique, the research examines the various factors that influence the sonic urban environment. The study's purpose is to create a sonic urban environment in historical sites that is compatible with existing roadways. Acoustics, sociological qualities of diverse noises, social demographic profiles of users, environmental conditions, and economic aspects are all factors to consider. It suggests that soundscape design will play an important role in the planning of cities that are both sustainable and pleasant to live in. People may develop a sonic urban environment by prioritizing safety and comfort, which implies they require a walkable city and liveability in their neighbourhood. There are certain guidelines for creating a liveable and walkable environment that lowers the usage of personal automobiles and allows for easy access with no barriers along the promenade.

The ongoing deterioration of El-Tahrir square in El-Mansheya urban environment necessitates development. The study was reviewed by pointing out the current state of the El-Tahrir square, which required to be improved in order to improve QOL in general and the sonic urban environment in particular. This applied study intends to reveal the issues in terms of the three pillars of sustainability, leading to design considerations particular to the local area. Its goal was to investigate and assess the acoustic performance of squares in Alexandria. The case-study method was semi-qualitative because the information needed for the social pillar focused around diverse users' perceptions, whereas the environmental pillar was concerned with sound measurements and the economic pillar with the specification of possible materials and processes. According to the case study, El-Tahrir Square is afflicted by a high level of sound that exceeds 80 dB during day and night, which has an impact on QOL along, despite the fact that noise levels should not exceed 65 dB according to the EEAA. Different forms of noise barriers could be optimized to enhance the human experience based on their benefits and drawbacks. Finally, it is recommended that noise management should be incorporated into the design process in order to achieve the goal of improving the soundscape, which is a significant aspect of the quality of life along the promenade. This study found that soundscape is an important feature of city planning that should be incorporated in the design to reduce the harmful effects of noise.

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