Role of noise pollution on urban design in new cities

(Case Study :New Cairo)

Abstract:

Noise is one of the main factors that can negatively affect human health and willingness towards living in a particular location. Over 30% of Europeans experience unwanted sound, especially in intensively urbanized areas (12). Noise can interfere with residential and community amenity and the utility of noise-sensitive land uses. Noise exposure can lead to a range of adverse effects including sleep disturbance and annoyance, impairing cognitive learning in children at school, psychological disorders, negative effects on the auditory system, obesity and an increase in the risk of cardiovascular effects (8), for these reasons the impact of noise can be a material consideration in the determination of planning applications and sustainable development. A lot of factors associated to urban planning have a considerable effect on volume of traffic, vehicles distribution, traffic conditions, and it is known that, from a temporal and spatial point of view, the most important source of noise in cities is road traffic (19). The World Health Organization (WHO) had estimated the burden of disease from traffic-related noise within the western part of Europe and concluded that on each year there is a loss at least one million disability-adjusted life years(DALYs)(38). Good acoustic design seeks to encourage and promote design outcomes that are proportionate to each development site, so the planning system has the task of guiding development to the most appropriate locations. It will be hard to reconcile some land uses, such as housing, hospitals or schools, with other activities which generate high levels of noise, but the planning system should ensure that, noise-sensitive developments must be sited away from major sources of noise (such as road, rail , air transport and certain types of industrial development)(22). The main aim of this study is the approach regarding the noise problem solution, instead of studying sound insulation materials and techniques, it focuses more on general urban planning regarding the shape of buildings, street orientations, positioning new parks , constructing earth embankments and traffic congestion control in order to reduce the noise impact on the citizens outside and inside their homes. Development plans

can provide the policy framework within which these issues can be weighed and local planning authorities should consider whether it is practicable to control or reduce noise levels, through the use of planning obligations (21). The research study had analyzed the relationships between urban noise and different specifics aspects of urban design through specific methodologies for noise pollution assessment and its relation to urban planning. In this way, the fact of finding a sustainable city could be closer, at least with respect to noise pollution. The study was done on most residential areas in the city of New Cairo. The results had shown that urban planning must be made with some logical considerations regarding sound propagation and amplification mechanisms in order to improve the comfort and people wellbeing in future developments. The methods followed for reduction of noise propagation and good urban planning include low-height barriers , ground treatments; acoustically absorbing facades and roofs of buildings, building morphology and quiet side and vegetation. Moreover, treatments at source consider tire friction, road condition, engine (whether electric or combustion), driving speed and acceleration, and further vehicle restrictions play an important role in noise mitigation. Quantitative reductions, in decibels, as well as qualitative aspects are presented. Conclusions: The described possible improvements to the urban sound environment, with focus on road traffic noise and building design as the dominant impairing factors, inform us about how a good urban sound environment can be reachable. However, to reach a good sound environment in reality, the work process of applied urban sound planning demands efforts across disciplines at early-stage planning, instead of traditional noise control applied late in the planning process.

Study Objectives:

Noise can have a significant effect on the environment and quality of life of individuals and communities. Good acoustic design is a holistic design process that creates places that are both comfortable and attractive to live in, where acoustics is considered integral to the living environment. The impact of traffic noise covers many aspects but in this study will focus on material loss and its relevancy to the vehicle and population health and growth.

Importance of the study:

This work makes a revision of spatial sampling methodologies for noise pollution assessment and its relation to urban planning .The importance of this guidance

study is to provide advice on how the planning system can be used to minimize the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business, outlines the considerations to be taken into account in determining planning applications both for noise-sensitive developments and for those activities which will generate noise, introduces the concept of noise exposure categories for residential development, recommends appropriate levels for exposure to different sources of noise; and- advises on the use of conditions that minimize the impact of noise.

Study Hypothesis:

Assess the relationships between urban noise and different specifics aspects of urban design and its relation to traffic conditions.

Introduction:

Noise pollution is a serious environmental and public health issue that affects the quality of life, well-being, and productivity of urban residents. It can cause stress, sleep disturbance, hearing loss, cardiovascular problems, and reduced quality of life (4). Noise pollution distribution in each city around the world is necessarily influenced by its own design, so it is an actual problem in all developed countries and it plays a major role in the decreased general health state of the population. Moreover a good relationships between urban planning and different factors such as urban density, urban morphology, urban land use, street distribution, street environment and green spaces were being founded (10) and this would allow better prediction, analysis and prevention of noise pollution through an effective design of urban environments (9). Since the first decade of XXI century, more studies had focused on the analysis of the relationships between the distributions of noise pollution and urbanism and stressed on street functionality (10,15). Noise can originate from various sources in urban environments, such as traffic, industry, construction, entertainment, and human activities, which vary in intensity, frequency, duration, and location, creating a complex and dynamic soundscape that can be challenging to be measured and regulated (18). Noise can also affect the quality of life and social cohesion of urban communities, as well as the biodiversity and ecosystem services of urban green spaces (25). Urban planners need to consider the characteristics and impacts of different noise sources, as well as the existing and future land use, population density, and topography of the city

(26). An improvement of the urban acoustic environment is linked with the United Nations Sustainable Development Goals, mainly Sustainable cities and communities (Goal 11), there are seventeen different sustainability development goals (SDG) which need to be achieved by the year 2030(34). This research focuses on one goal (number 11), which is about making cities and human settlements inclusive, safe, resilient, and sustainable (34). Green and other public spaces demand sufficiently low noise levels to provide the desired function (30). The recent WHO Environmental Noise Guidelines for the European Region recommends that the day-evening-night noise level from road traffic should be below 53 dB [40]. Urban planners have a key role in designing and implementing noise control interventions that can reduce the exposure and impact of noise on the population. Making sufficient improvement requires the consideration of all available tools, so we need to mix classical and novel noise control engineering approaches and exploit the benefits of soundscaping (29).

Noise control engineering approaches:

Noise maps, noise indicators, noise exposure models, and noise surveys, noise databases and noise dashboards assess the noise situation and its impacts on different population groups, land uses, and ecosystems(17) Noise mapping and monitoring can help urban planners to identify noise hotspots, assess noise exposure and annoyance, evaluate noise mitigation measures, and inform noise policies and standards to support the planning and decision-making process(36). Noise levels can be expressed in different units, such as decibels (dB), A-weighted decibels (dBA), or day-night average sound level (Ldn). Urban planners can compare the noise levels with the standards and guidelines established by local, national, or international authorities, such as the World Health Organization (WHO)(36)

Noise control strategies and measures :

There are three main types of noise control strategies and measures: source control, transmission control, and receiver control. Source control aims to reduce or eliminate the noise emission at the origin, by using quieter vehicles, machinery, or devices, implementing low-noise road surfaces, traffic speed limits, and public transportation systems management to reduce traffic noise .Transmission control aims to block or attenuate the noise propagation along the path, by installing noise barriers, sound insulation, acoustic glazing, and green roofs to block or absorb

noise; providing noise-sensitive areas with adequate setbacks, buffers, orientation, and ventilation, and regulating noise emissions, enforcing noise standards, and raising awareness and education on noise issues(22,23). Noise indicators include quantitative and qualitative measures such as medical records, physiological tests, psychological scales, or self-reports that can describe, compare, or evaluate the noise situation and its changes over time. Urban planners can use noise indicators to monitor and report the progress and performance of the interventions, and to communicate the results to the public and decision-makers (10,19). There are many examples of noise control in urban planning from around the world (New York City's Quiet Streets program intends to reduce traffic noise through the installation of speed humps, signs, and markings), (11,12).

2- Integrating noise control into urban planning is an essential step in a comprehensive, systemic approach to urban development that takes into account the interrelationships between noise and other environmental, social, and economic factors(2). Urban planning can be instrumental in creating quieter environments by incorporating noise criteria and objectives into urban design, land use, and zoning decisions to ensure compatibility between different functions and activities. Moreover, promoting mixed-use, compact, and walk able urban forms that reduce the need for motorized transport can enhance the livability and attractiveness of urban spaces (26,27).

3- Enhancing the natural and built environment with green and blue infrastructure such as parks, gardens, waterways, and fountains can provide noise mitigation, biodiversity, climate adaptation, and recreation benefits (31).

4-Finally, it is important for urban planners to update and revise noise policies, plans, and actions based on the latest evidence, feedback, and learning (19). The regulations and standards set limit the criteria for acceptable noise levels, noise zones, noise mapping, noise monitoring, and noise abatement measures (36).

STUDY APPROACH AND KEY ISSUES (Material &Methods):

A-Architectural design plan to control noise in buildings:

A proper architectural design helps in noise control in buildings to a great extent. There are four types of design approaches to reduce noise: (1) to locate, orient, or configure the building to reduce noise at building site, (2) to provide additional

exterior barriers such as walls or berms, (3) to fortify the building shell, and finally, (4) to vary the interior sound absorption (6,21).

1-Building Location and Orientation:

The location and orientation of building on a site can aid in controlling noise. For each doubling of the distance away from a highway or a railway you can expect a reduction of about 4 -6 dB, (Figure1) (21).Moreover, if the building site is close to a major highway or railway and the building is to be fairly long, two design concepts can be employed, one is to orient the building's major axis perpendicular to the direction of the highway or railway, and then to locate the noise-sensitive exterior rooms at the end of the building farthest from the roadway or track. A second design concept is to orient the building's axis parallel to the highway or railway and to provide materials having an extremely high SIR(Shell Isolation Rating) on the facade facing the noise source, while placing noise-sensitive rooms on the facade shielded by the building itself(6).

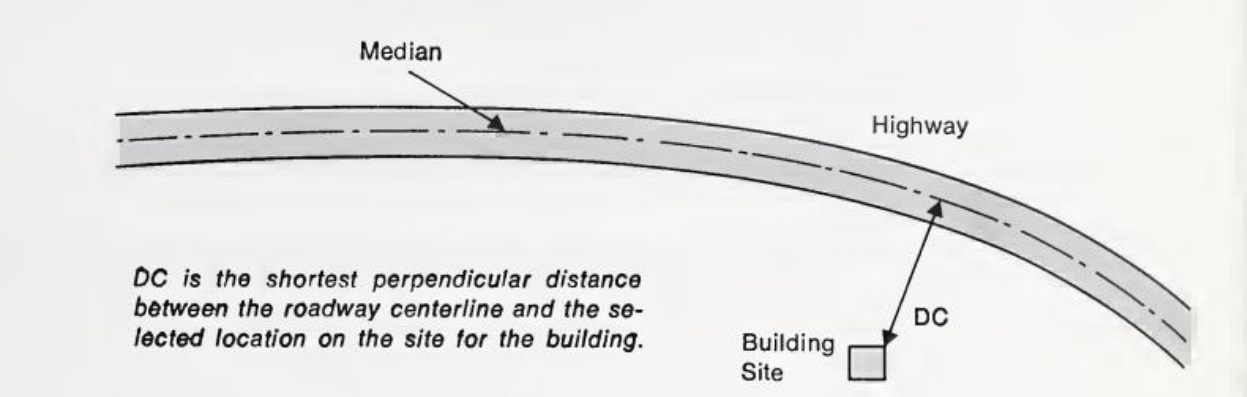


Figure (1):Nearest perpendicular distance between the center of the roadway and the selected location on the building site, DC, in feet(6)

It is especially important that buildings not be parallel when located on both sides of an expressway in order to avoid multiple reflections of sound waves which increase sound levels (21), and this can be found in research study in Petroleum Company site at New Cairo, whereas its building axis is perpendicular to high way (figure 2b). A cluster of buildings with no parallel building faces will be applied on Petrogas company and Bakier Stationary on fifth settlement (New Cairo),figure 2b

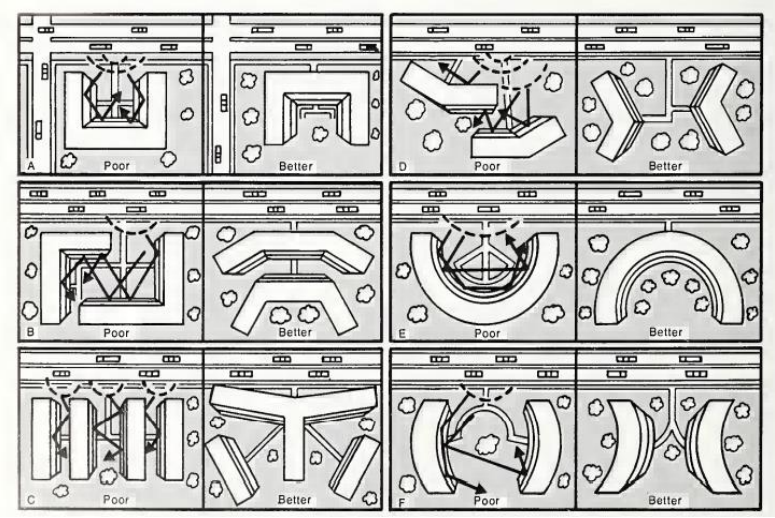
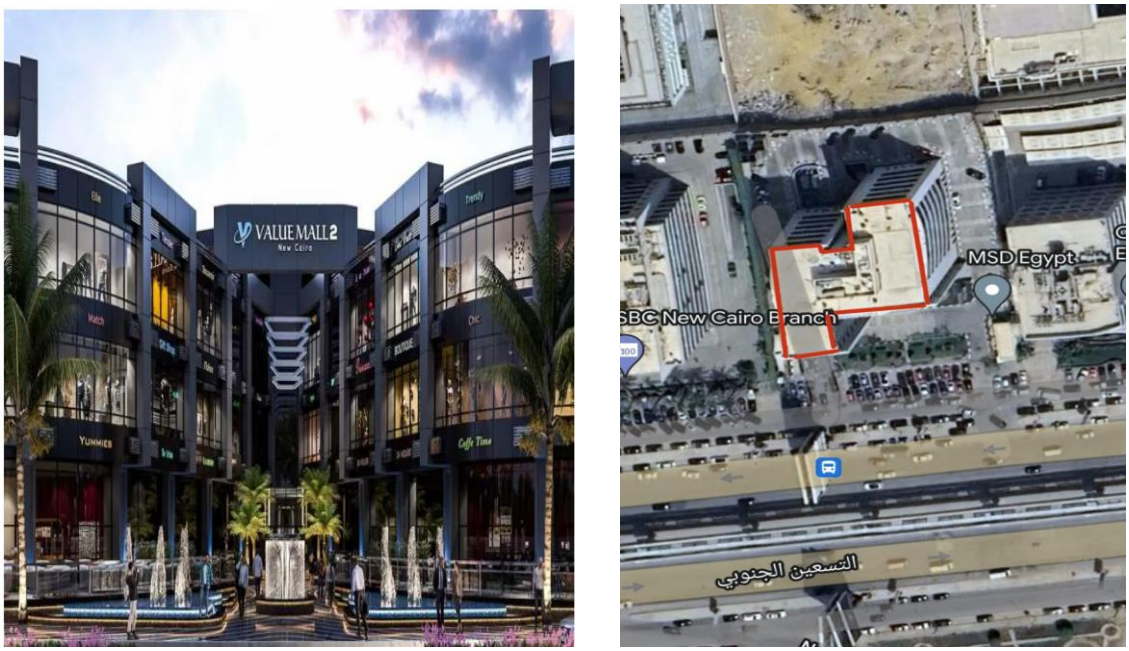
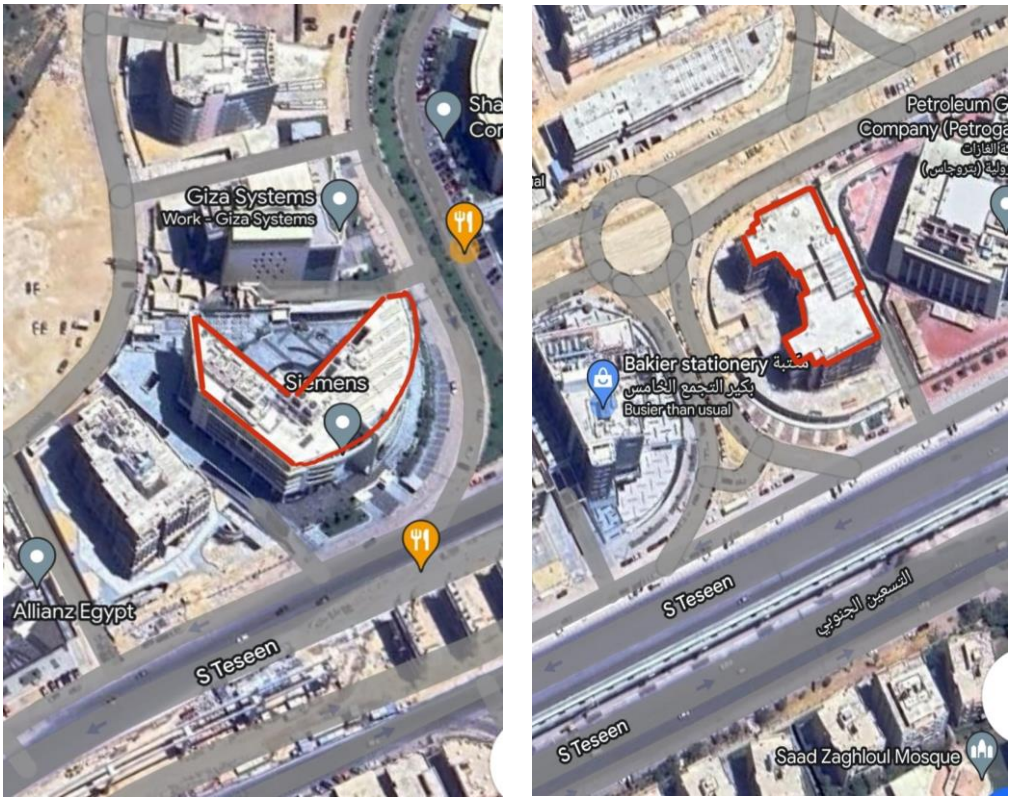


Figure 2a: Better and bad Orientation of Building's Sites and Courtyard ,(6)

2-Slightly curved buildings can be beneficial and this idea was applied on Siemens building and Value Mall 2 in New Cairo in research study (figure 2a).U-shaped buildings or semi-enclosed courtyards provide areas for multiple reflections and should not be used as outdoor activity areas, because they tend to be noisy, Fig (2 a,b,c,d) (21).



Fig(2b)Different Orientation of Building's Sites(Researcher)



Fig(2c): Effect of curved buildings , the building's major axis perpendicular to the direction of the highway and its site is relatively far from traffic way and semi enclosed courtyard on noise mitigation (case study) (Researcher)

3- Buildings façades are the primary surfaces upon which the sound emitted within the street is reflected and their design contributes to the reduction of noise level over their fronts. The current study highlight the screening effect provided by the balconies and the benefits of the application of sound absorbing material on the noise reduction over the façade (3-10 dB). These reductions are much higher than those obtained by increasing the sound absorption properties of the street paving (1.5 dB) averagely, thus underlining the crucial role of façade design in outdoor noise mitigation, (figure 2d),(5,8). Mechanical rooms and shops of secondary schools can be arranged on the noisy side while libraries, auditoria, and classrooms are deployed on the quiet side (2).

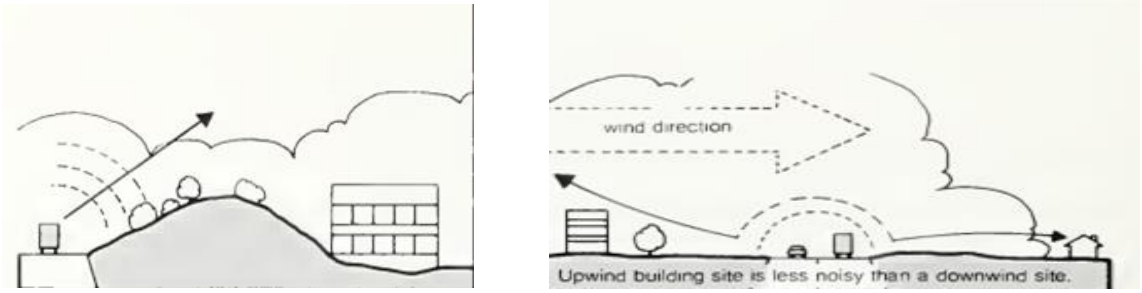
Fig (2d):Effect of building façades with sound absorbing material , street paving and balconies depth on noise mitigation(15,Researcher)

4-Sites on rolling terrain separated from rail- ways and highways by heavy, wide stands of trees are generally quieter than sites located in hollows or on flat, open (19) , and this can be clearly seen in most districts of New Cairo, figure(3)

Figure (3) Large green areas between buildings and traffic way to reduce noise pollution in New Cairo,1st settlement (case study) (Researcher)

5- The designer can provide some form of shielding between the source and the receiver, or building in the form of wails, natural barriers such as earth berms, rows of intervening buildings, vegetation, (Fig 4),(6).

6- At large distances the upwind side is generally quieter than the downwind side of a noise source (6). The wind tends to bend the sound path upwards, as shown in (Figure 5), thereby reducing the sound energy that impinges on an unwind site.



Fig(4) Use of Natural Noise barriers (5) Selection of Building Sites relative to Wind Direction(6)

7-Sites near hills or traffic intersections are generally unfavorable due to the acceleration, deceleration and braking of vehicles (6). This can be shown in the current study in Bait El Watan project which is located between Rehab and Madinaty, specifically on the extension of the North 90th Street, Fig(6).

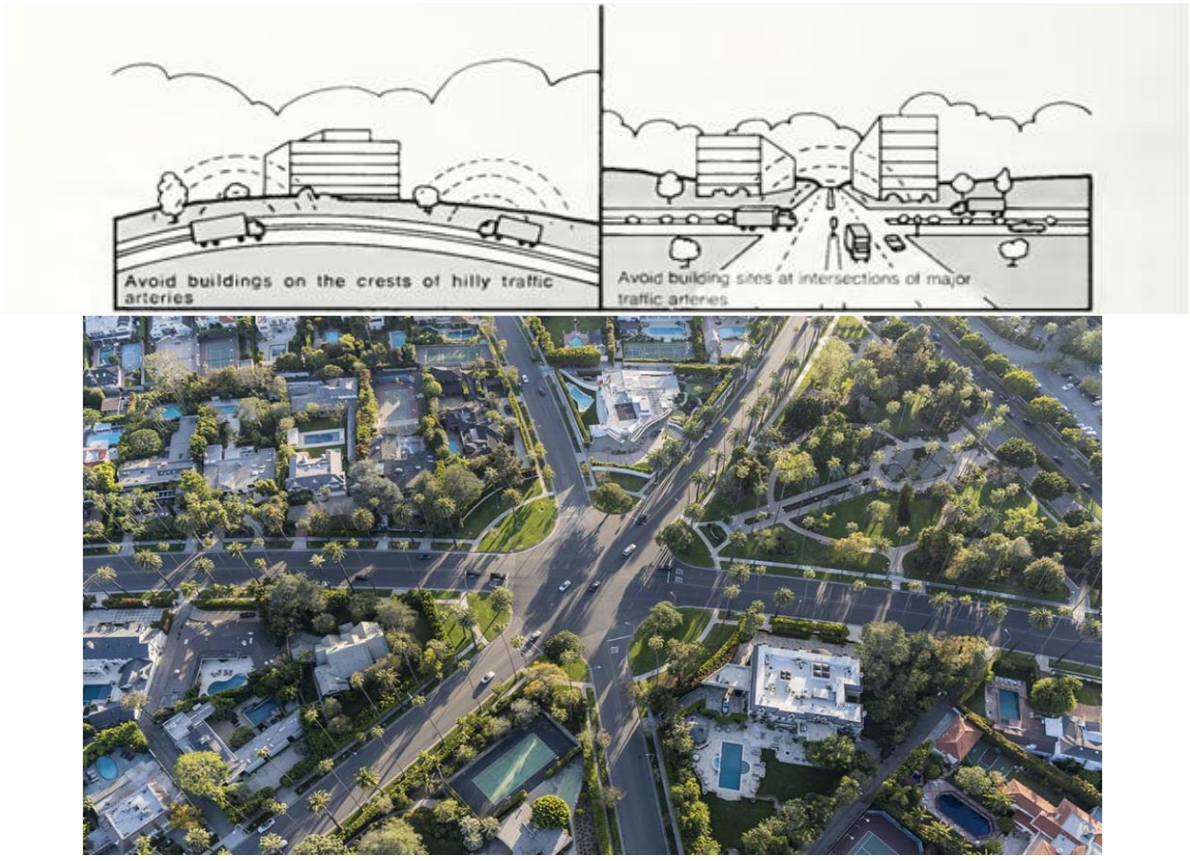


Fig (6)Building Sites near Hilly Traffic Areas and Traffic Junctions (Bait El Watan Neighborhood in the vicinity of New Cairo) (6,Researcher)

8-To prevent sound transmission directly through the sound barrier, it should be constructed of a material whose surface weight density is greater than 4lb/ft^2, located close to the source to decrease the angle of diffraction, hence the attenuation, is maximized .The building shell is the last line of defense against noise, and its isolation is related to its mass, stiffness, continuity of construction, sound absorbency of interior wall coverings, and freedom from cracks or holes (usually achieved by high quality construction). (Figure 7),(6).

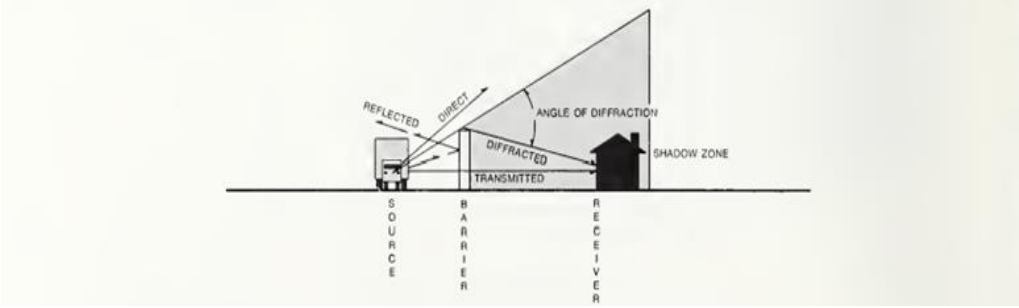


Fig (7)shielding by a wall and Earth Berm and decrease the angle of diffraction ,(6)

9-The arrangement of elements like window placing, door, the position of the bedroom, balcony, courtyard by proper acoustical planning help in reduction of unwanted noise within the building(1,2)(figure 8a).

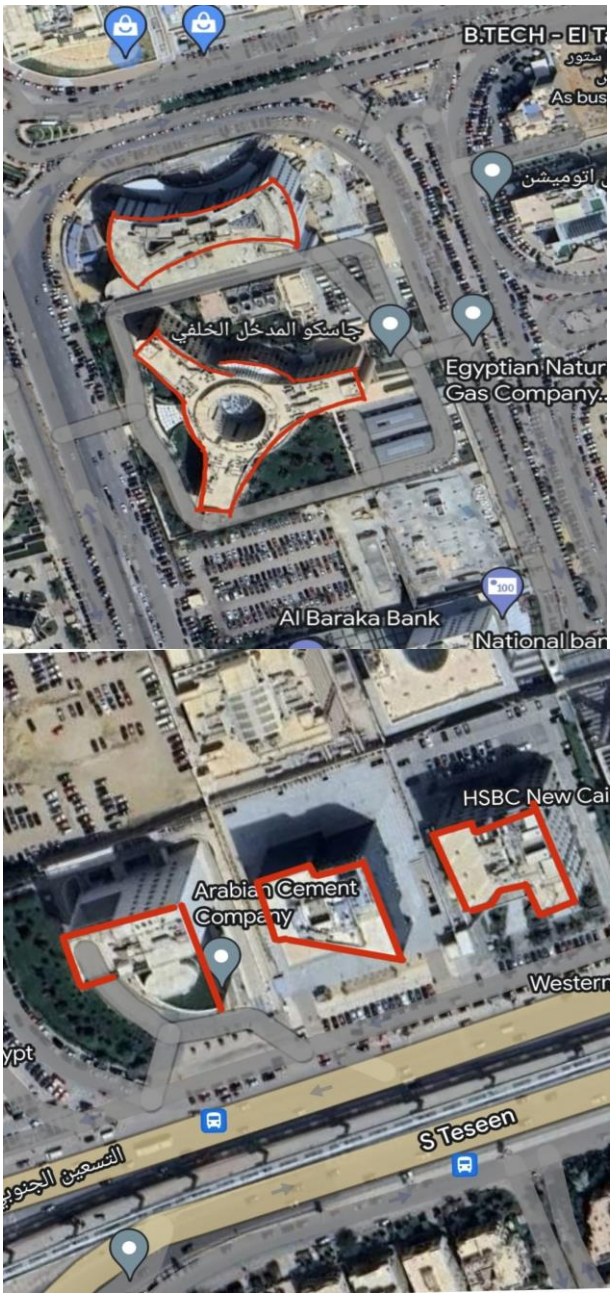


Figure (8a) Courtyard arrangement which reduce unwanted noise on building (case study) (Researcher)

An architectural program and a scheme for a proposed building, predict acoustical conditions in the rooms of the building, or in the outdoor activity areas of the

building, and bring all spaces to pre-established noise criterion levels and decide steps of reducing noise in the building, (figure 8b).

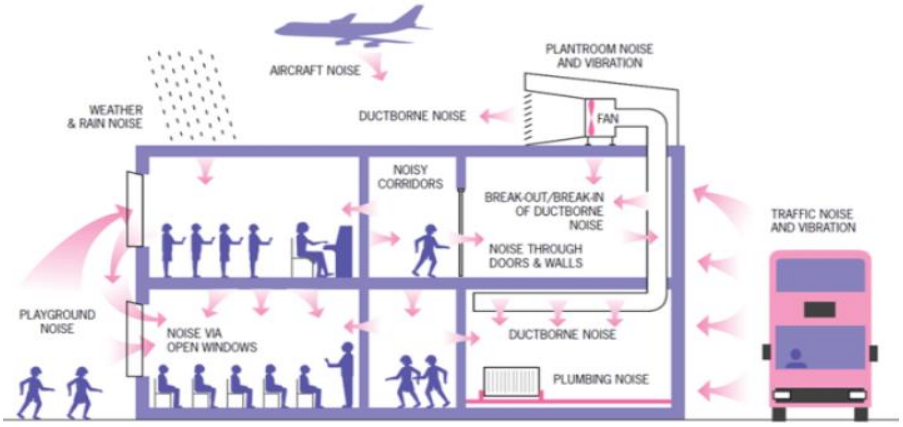


Fig (8b): Sources of noise in building,(6)

B-Traffic Congestion :

The desire for safe, attractive and vibrant streets is reflected in a range of existing transport, planning and environmental policies and objectives to address how neighborhoods, villages and towns are created and protected. They relate not only to road safety and civil engineering, but also to town planning, urban design, landscape architecture and conservation, (21,24).

The main factors which determine the level of road noise and air pollution are traffic volume, speed, levels of congestion and the proportion of Heavy Goods Vehicles (HGVs)(figure 9). Urban Relief Roads are generally routed around urban areas and are commonly referred to as By-Passes or Outer Ring Roads which are away from cities, towns and villages provided they are clearly separated from the urban fabric (figure 10).This idea is applied in The city of New Cairo which is located east of the Ring Road in the space between the Cairo-Suez Desert Road and the Cairo-Ain Sokhna Desert Road to relief road's congestion. A primary function of all transport policies has been to reduce the waste of resources caused by congestion. On the other hand, the sustainable modes of transport like walking, cycling and public transport can cater for very high volumes of movement in a far more efficient manner. One of the outcomes of a more connected, traffic-calmed network will be reduced car dependency and increased use of more sustainable modes of transport (24), this is the most balanced way of addressing traffic congestion. Higher levels of connectivity for all users will also enable greater vehicular permeability, albeit at slower speeds.

SPEED AND NOISE REDUCTION

Speed Reduction	dB (A) Reduction
from 70-60 km/h	1.8
from 60-50km/h	2.1
from 50-40km/h	1.4

TRAFFIC AND NOISE REDUCTION

Traffic Volume Reduction	dB (A) Reduction
30%	1.6
40%	2.2
50%	3.0
75%	6.0

Figure (9):Noise reduction effects of lowering traffic speeds and volumes,

Source: Smarter Travel - A Sustainable Transport Future: A New Transport Policy for Ireland 2009 - 2020.. Department of Transport

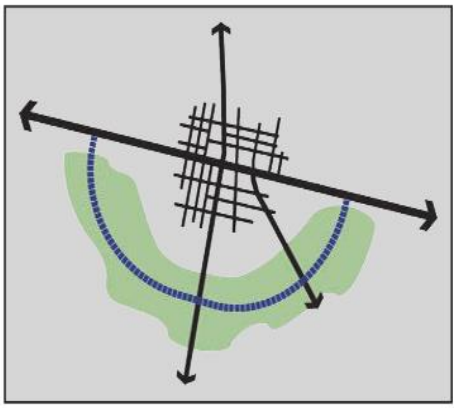


figure10: Outer Relief Roads

Source: Department of Environment, Heritage and Local Government,2012"*Spatial Planning and National Roads: Guidelines for Planning Authorities".*

Case Study:

1-Introduction:

The city of New Cairo is one of the largest new cities, and this city is considered one of the third generation cities that were established by Presidential Decree No. (191) for the year 2000, its area is estimated to be about 70 thousand acres, and it consists of several residential communities, the largest of which is the Fifth Settlement, in addition to Al Rehab and the First and Third Settlement. The city of New Cairo is located east of the Ring Road in the space between the Cairo-Suez Desert Road and the Cairo-Ain Sokhna Desert Road and given that environmental monitoring is one of the most important tools for studying the environmental situation in urban communities(37). the Ministry of State for Environmental Affairs and its executive apparatus have placed it among its priorities, because of its great importance not only in measuring the release of environmental pollutants, but also in determining the sources of pollution and finding effective solutions to reduce these pollutants. Framework environmental noise levels were monitored and evaluated in the city of New Cairo, and the most important sources of noise were identified in it, as it is one of the cities of the new urban communities, so that the results of these measurements can be used in proposing the necessary technical solutions and discussing the possibility of reducing noise levels in the city and using the land optimally during the establishment of projects and the distribution of activities related to it. The national network for monitoring environmental noise levels has been implemented since March 2007 until now, which currently consists

of 40 noise monitoring stations in the governorates of Greater Cairo, including (Cairo - Giza - Qalyubia)(figure 11).

It is the first in the region in terms of size and efficiency, as the network consists of 27 stations in various neighborhoods of the Greater Cairo governorates, with their high population density, and 11 stations have been installed in some cities of the governorates (Sharqia - Gharbia - Alexandria - Ismailia - Buhaira - Dakahlia - Fayoum - New Beni Suef - Red Sea - South Sinai).The noise levels monitoring network aims to assess noise levels and prepare a map of environmental noise for the Greater Cairo Governorate and the capitals of the governorates to benefit from the results of those measurements in the noise control plan, urban planning for the new structure, and reforming the existing situation to reduce noise levels in major cities, as well as optimal

land use during the establishment of projects(37).The results of monitoring noise levels for the day and night periods were compared with the permissible limits in the executive regulations of Environment Law amended by Law No. 9 of 2009 and its executive regulations, and for the different areas in which noise monitoring stations are located, to identify the extent of their conformity or violation of the law.

Annual report are prepared for:
Greater Cairo governorates and sent to the governors to take the necessary measures to reduce noise levels.
Resolution No 456 of 2020 was issued by the Ministry of Local Development regarding setting closing and opening dates for shops and malls in all governorates of the Republic, in coordination between the Ministries of Environment and Local Development to issue a decision to close shops in the framework of reducing high noise levels during the night period and based on monitoring reports issued by the Ministry of Environment during the year 2020.

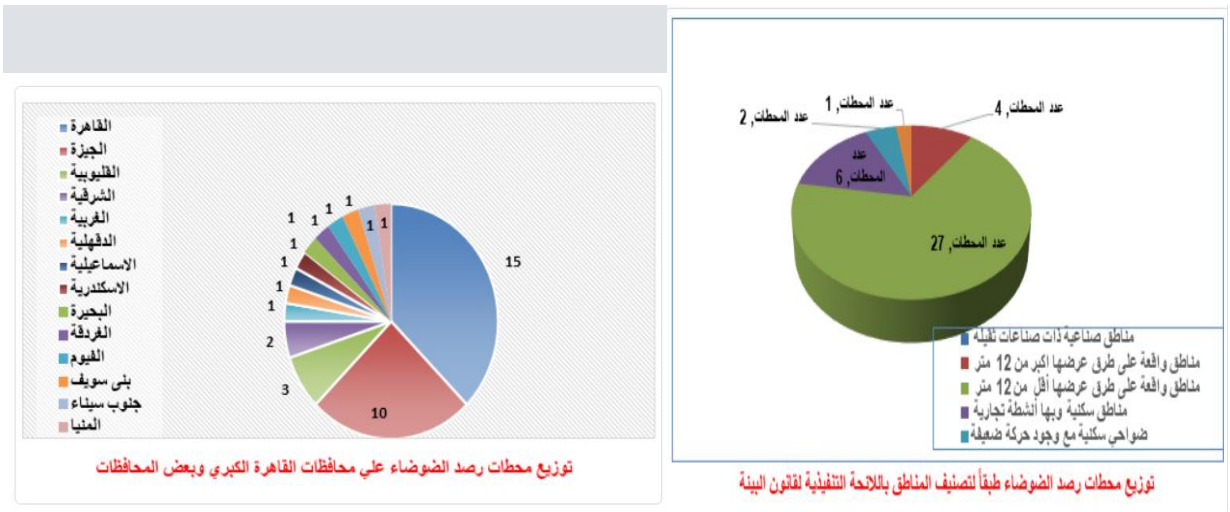


Figure (11): Noise monitoring station distribution,(37)

2-Objectives

1-Evaluating the noise levels to which the residents of New Cairo are exposed and their conformity with the limits established by law in the executive regulations of Environment Law No. 9 of 2009
2-Retrieving from the results of the measurements that were made in that city to work on reducing the current environmental noise levels and bringing them to the levels stipulated in Law No. 9 of 2009 and its executive regulations.

3-Equipment and Legal Standards (Methods of determination):

A. Local and international standards have been applied to conduct monitoring and measurement of environmental noise levels using the following mobile stations:
1. Mobile station monitor: Bruel & Kjaer sound analyzer, Mobile Unit, Type 2250 with Frequency analyzer
2. Noise level measuring device: Bruel & Kjaer sound Level Meter, type 2250
3. Device calibration brand: Bruel & Kjaer calibrator, type 4231

Picture 1. Location of the measurement in front of the Emad Hazem Resort,(37)

B. **Some sites were chosen on roads exposed to high traffic density**, as well as other sites with weak traffic and limited service activities. Environmental noise levels were monitored in these sites during the day (from eleven in the morning until one in the afternoon) for an hour in each site (37).

At the following sites:

a. Residential areas located on 90th Street (4 different locations)

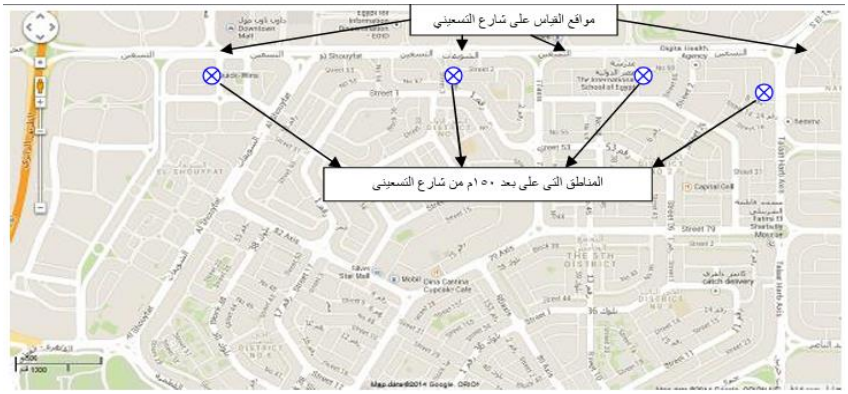
b. Within the residential areas and 150 meters from the 90th Street (4 different locations)- Inside International Schools Zones - South Academy

c-In front of the New Cairo Court- In front of the City Authority (1 point).

d- The third residential neighborhood with low-cost.

e-In front of Al-Azhar Institute - Third District.

f-In Front Of El Ferdous Mosque - Third District.



Picture 1. A map showing the locations of the measurements on the 90th Street ,(37)

C. Several parameters of noise levels were measured, **namely**:

• Average equivalent noise level during the measurement period: L(A)eq

• The maximum equivalent noise level during the measurement period: L(A)max

• The lowest equivalent noise level during the measurement period: L(A)min

D. **Frequency analysis of the sound level measured in hertz** was carried out and the main sources of noise in the city were identified (37).

E. **The results of the measurements were compared with the legal standards** mentioned in Table No. (3) of Appendix No. (7) of the Executive Regulations of Environment Law No. 9 of 2009 regarding permissible noise levels in different areas, as they included the sites where environmental noise levels were monitored in New Cairo. Three different types of regions, according to the following table, (37):

Measurement sites	Site description	The permissible limit for the equivalent noise level in decibels $L(A)_{eq}$ (dB)	
		Morning	Night
The areas in which the locations were measured Al-Mayadeen or the 90th Street located on the site in the different city	Areas located on roads with a width of 12 m or more, and there are some other activities	70	60
The scattered locations within the city are within the low-cost third residential district, as well as within the International Schools area	Residential areas located on roads less than 12 m in which commercial activities, administrative activities, recreational activities, or amusement parks	65	55
The location inside the residential area (150 m from 90th street)	Residential suburbs with little movement and limited service activities	55	45

Table No (3) The results of the measurements were compared with the legal standards

F. Contour maps of the environmental noise levels were drawn in the areas located on the ninety road in New Cairo city in the daytime, using the noise prediction driver program: Prediction Software Type B&K 7810 (Version 5)

4. Results :

Table (4.1) Results of noise levels of the sites located on both sides of a width of a 12 m or more from high way and other activities(37)

Site	Site description	The legal permissible limit LA_{eq} (dB)	Noise levels (dB)		
			LA_{eq}	LA_{max}	LA_{min}
1	The 90th Street in front of the square heading to Al-Narges neighborhood	70	70	94	56
2	The 90th Street in front of the Air Force Hospital		73	91	60
3	The 90th Street in front of the National Bank		71	94	65
4	The 90th Street in front of Down Town		67	86	57
5	In front of New Cairo Court		72	94	57
6	In front of the New Cairo City Authority		62	86	53

Table (4.1) Results of noise levels of the sites located on both sides of a width of a 12 m

Picture 2:Measurement location in front of Air Force Hospital ,(37)

Site	Site description	The legal permissible limit LA_{eq} (dB)	Noise levels (dB)		
			LA_{eq}	LA_{max}	LA_{min}
1	in front of Seven Star Mall, 150 meters away	55	62	88	46
2	in front of the Air Force Hospital, 150 meters away		55	78	46
3	in front of the National Bank, 150 meters away		54	78	42
4	in front of Down Town, 150 meters away		55	74	44
5	in front of New Cairo Court		55	79	46

Table (4.2) Results of noise levels of residential areas with low traffic and limited service activities (37)

Picture 3: Measurement location inside the low traffic residential area,(37)

Site	Site description	The legal permissible limit LA_{eq} (dB)	Noise levels (dB)		
			LA_{eq}	LA_{max}	LA_{min}
1	the third low-cost residential district	65	65	83	49
2	In front of Al-Azhar Institute		65	88	52
3	in front of Al-Firdous Mosque		64	85	46
4	in front of the international schools		60	80	45

Table (4.3): Results of noise levels of the residential areas within less than 12 m of the highway (37).

Picture 5: Measurement location in the Third Settlement with lower economic class,(37)

5. Analysis of the results of measurements

A. It was found from the results of the measurements in the areas located on roads whose width is greater than 12 m during the daytime period in Table (4.1) that the equivalent noise levels L(A)eq are consistent with the limits permitted by law in the executive regulations of the Environment Law No. 9 of 2009 in some areas. Whereas the results exceeded the legally permissible limits in other areas in different locations of the 90th Street or the different squares, where the results of the measurements ranged between 73-62 dB.

B. Table (4.2) showed the consistency of noise levels in all residential areas with weak movement and limited service activities, which are located at a distance of less than 150 m from public roads, except for the residential area located 150 m from the New Cairo Court, in which noise levels reached 62 dB.

C. It also appears from Table (1, 2) that the noise levels in the monitoring sites at a distance of 150 m from the roads whose width is greater than 12 m are lower than the noise levels in the sites where the monitoring was carried out on direct roads by a difference ranging between 10-18 decibels, as shown in the following figure.

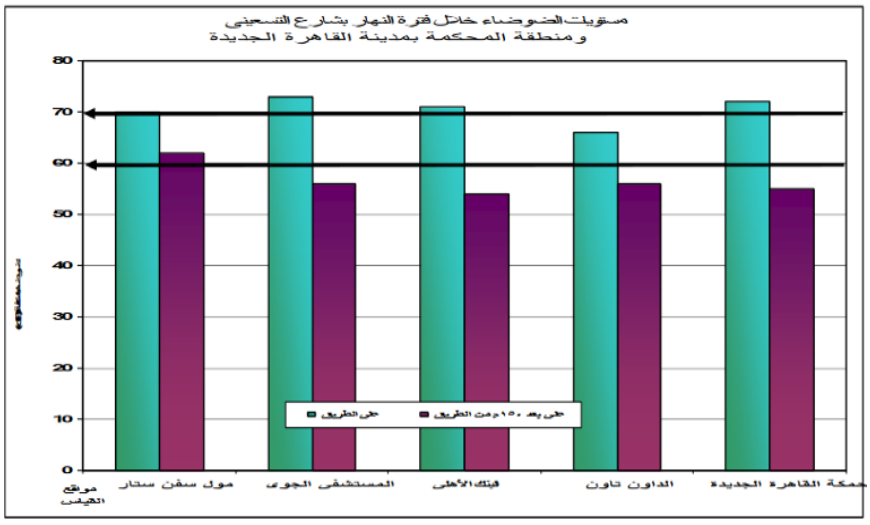


Figure No. 12: shows the difference in noise levels in the residential areas located on the road and the areas located 150 meters away from this road (37)

D. The results of the noise levels for all the sites that were monitored in the areas located on roads with a width of less than 12 m are consistent with the standards contained in the executive regulations of the Environment Law No. 9 of 2009. **6**. Analysis of the Frequency of Noise Sources:

Frequency analysis of the noise levels measured on 90th Street indicates that the

highest noise levels are in the frequency range of 3000-500 Hz. This indicates that the noise sources in this road are caused by the traffic of different types of vehicles, which includes the sound of engines and the friction of tires on the road.

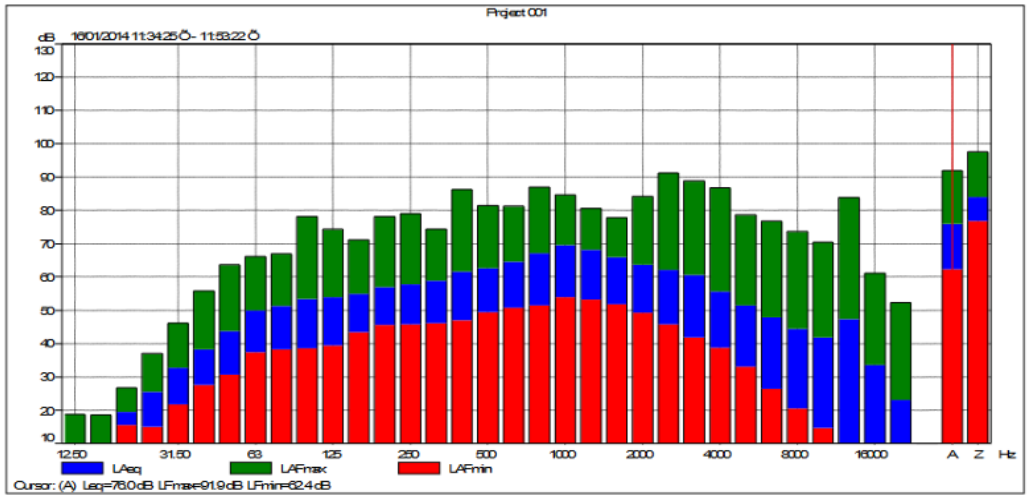


Figure 13 shows the analysis of the sound level frequencies for the sites located on the ninety road during the day (37)

7. Contour map of the environmental noise along the 90th Street, New Cairo City (using the noise prediction software)(figure 14).

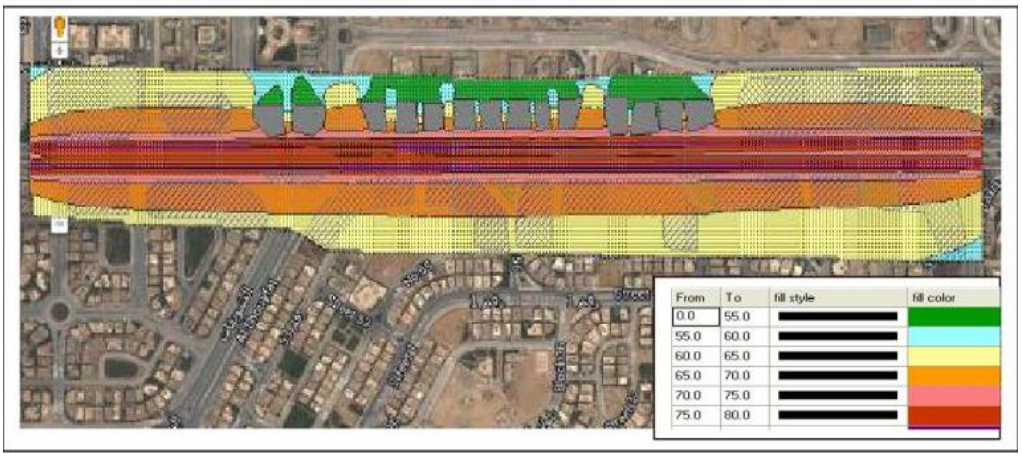


Figure (14) shows the contour map of environmental noise levels in the residential area located on or near the 90th Street, which was prepared using the noise forecast program ,(37)

The noise levels in the map are consistent with the field measurements prepared on this road, which indicated that the noise levels ranged from 75 to 80 dB on both sides of the road and noise levels are reduced by up to 20 dB at a distance of 150 m from the road.

8-The urban development patterns depend upon population density, industrial structure, built-up area, transport network, commuting, and natural landscape factors. Our research found that noise complaints tend to be higher in service dominated regions with high population densities; large and uneven regions also tend to have more noise complaints, as do clustered regions. However, dispersed, fragmented, regions having ragged boundaries are likely to have less noise complaints. These findings were confirmed by analysis of transport networks and commuting factors. Finally, regions with more natural landscapes and greater separation of residences from workplaces also have fewer noise complaints (13)

Discussion :

With the rapid increase in urbanization, exposure to noise is increasingly recognized as a common and serious problem worldwide. Many studies have shown that noise is a primary contributor to certain risk factors related to physical and mental health, such as loss of hearing, sleep disorder, and cardiovascular stress (6,14). A series of policies and actions have been implemented to reduce the impact of noise. This research indicates that urban planning parameters can be applied to achieve better sound environments, and can inform urban planners from the perspective of acoustic impacts, potentially leading to more effective noise management strategies and planning progress. The governorates of Greater Cairo has established the national network for monitoring environmental noise levels since March 2007 until now, which currently consists of 40 noise monitoring stations as the EU Environmental Noise Directive (24). From a noise level perspective, a comparative study by (Hong A et al., 2019) demonstrated that there were significant differences in the spatial noise level distribution between high heavily built urban structure types with rising road network density and vehicle kilometers per square kilometer per 24hours and low-density cities and this coincides with the research paper results whereas residential areas ,Down Town region and Bank Center areas along 90th Street suffer from noise level that exceeded the legally permissible limits. Research study agrees with Margaritis and Kang (2017) results which focused on the relationships between green-space-related morphology and noise pollution, and found that at the urban and kernel scale, cities with higher green-space coverage were found to have lower day-evening-night noise levels(30,31). Through analysis of the contour map of environmental noise levels in the residential area located on or near the 90th Street

,the research study found that linear arrangement of buildings have a higher probability of being noisier, and that dispersed patterns are related to lower noise levels as the results of(Huan Tong and Jian Kan,2020) study. Moreover, E.Badino et al. (2019) found that the sound level over the facade can be reduced by up to 6.5dB by absorbing balconies and loggias and by 10dB with entirely absorbing sound facades and this clearly shown in research paper on the facades of the Air Force Hospital, Bank center areas and most of residential regions along 90th Street. Furthermore, previous studies had shown that flat facades inclined upwardly or vertical facades, curved shape and nonparallel buildings were most efficient for noise reduction; and all these were shown clearly in case study (13) . According to the above considerations, for urban planners and policy makers, the relationship between urban development patterns and noise complaint matters is still lacking, especially at a large scale, so this research aims to categorize the indicators of urban development patterns relating to planning and land scape into six groups: population, industrial structures, built-up areas, transport networks, commuting, and natural landscapes.

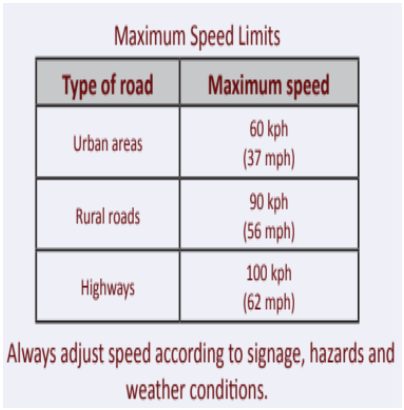
-Vehicle traffic noise can degrade the environment quality of life so, the goal in neighborhood planning should be to create a network that makes walking, cycling and public transport the easiest and most appealing choices to improve the social quality of life (17,34).

-Better street design in urban areas will facilitate the implementation of policy on sustainable living by achieving a better balance between all modes of transport and road users (34). It will encourage more people to choose to walk, cycle or use public transport by making the experience safer and more pleasant. It will lower traffic speeds, reduce unnecessary car use and create a built environment that promotes healthy lifestyles and responds more sympathetically to the distinctive nature of individual communities and places, all these parameters are found in case study, where pedestrians and cyclists are present in larger numbers, especially in Centers, and along 90^{th} street, because the speed limits applied should not exceed (30-40km/ h) which is requirement of Smarter Travel (2009)(figure15,16) within the central urban areas. In addition vehicle movement priorities are low, such as on Local streets, lower speed limits should be applied (30km/h) (31).

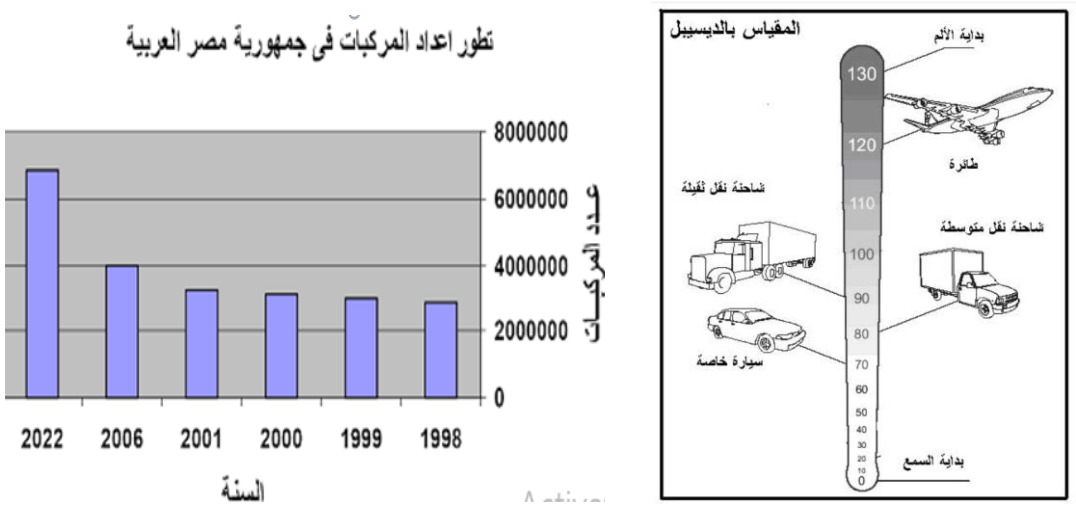
-Concerning planning for the future, it seems likely that the demand for mobility will persist. Linked with modes of transport, using aircraft, trains, buses, cars, there will be sounds, which must be kept in control. It should be pointed out that also electric vehicles can cause large noise exposure from the traction (i.e., tire road noise), irrespective of the engine being of electric or combustion type (37). The recent WHO Environmental Noise Guidelines for the European Region recommends that the day-evening-night noise level from road traffic should be below 53 dB [36].

-Well-designed transport policies and infrastructure investment priorities can lead to far-reaching reductions in traffic-related health risks from air pollution, noise stressors and injuries, while reducing climate-forcing greenhouse gas emissions,(32).

Increase in perceived noise strength	Noise level (in dB)	Increase in traffic volume	Traffic volume vehicles/hou) (r
Basis	52	Basis	1000
stronger 7%	53	25%	1250
stronger 15%	54	60%	1600
stronger 23%	55	100%	2000
stronger 50%	58	300%	4000
stronger 80%	60.5	600%	7000
stronger 100% double the noise) (power	62	900%	10000



Figure(15):Rates of increase in noise level and increase in perceived noise intensity depending on the increase in traffic volume (26) ,
Figure (16):Road Safety Review: Egypt ©ASIRT 2022(Association for Safe International Road Travel) (swideg-geography,blogspot.com/2019/10/blog-p)



Figure(17):Increase number of traffic since 1989 till 2022 in Egypt.
The level of noise emitted by various methods of transportation
(swideg-geography, blog spot.com/2019/10/blog-p)

Recommendation

A. Conducting periodic environmental monitoring through the Environment Department of the City Authority to find out the extent of the commitment of shop owners and the owners of service projects in the city to the environmental impact studies and work to choose the appropriate site when carrying out any new service or commercial project within the city and following up with these operations to ensure that noise levels do not exceed the limits stipulated by the executive regulations of the Environment Law(37).

B. The issuance of directives from the Head of the City Authority to manage the noise levels in city of New Cairo and to tighten control and work on implementing the noise-related articles in the executive regulations of Traffic Law No. 66 of 1973 as amended by Law No. 155 of 1999, with placing guiding signs for the citizen in clear and visible places in the city along with tightening regulation of the speed of vehicles within the city, which should not exceed 30 km/h,(37).
C. Expansion of planting trees and greens on both sides of the roads and in the central islands of these roads, to contribute to the process of absorbing the noise emanating from vehicles (31).

D. Ensure that the roads are finished in accordance with the standard specifications for paving, as the thickness of the asphalt layer must not be less than 12cm (37).

E. Taking into consideration a buffer distance (a precinct of the road) between the road and establishments that have a sensitive nature such as (hospitals, schools, public libraries, etc...), so that the level of exposure to road noise decreases, with the necessity of preventing heavy transport traffic within these areas, (37).
F- Some locations near the New Cairo court require the implementation of some of the recommendations in order to lower the noise levels to the permissible levels, so that the city can be declared environmentally friendly and can follow the United Nation Development Goal (11), (37) .

Future plans :

Based on the presented results, the author proposes several suggestions for urban planning, aiming at the noise limitation:
• Excluding transit traffic and introducing speed in urban areas requiring LAeq under 40 dB (spatial functions like residential, education, recreation).
• Application of well-designed (aesthetics, driver visibility, pedestrian safety) acoustic screens if another noise reduction is not possible,
• Avoidance of long narrow streets with tall buildings.
• Creating areas for recreation at a distance from noise sources,
• Shielding recreation and leisure zones with massive buildings if at distance is not possible and designing the greenery (also roofs)
• Building buffers of sound energy absorption, like using soft architectural and urban materials if possible (facades ,ground, sand, green walls, roofs).
•The tunnels may effectively shield road traffic noise

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دور التلوث الضوضائى على التصميم الحضرى فى المدن الجديدة (دراسة حالة: القاهرة الجديدة)

ملخص:

الضوضاء هي أحد العوامل الرئيسية التي يمكن أن تؤثر سلباً على صحة الإنسان ورغبته في العيش في مكان معين. أكثر من 30% من الأوروبيين يعانون من أصوات غير مرغوب فيها خاصة في المناطق الحضرية الكثيفة(12).يمكن أن تتداخل الضوضاء مع وسائل الراحة السكنية والمجتمعية واستخدامات الأراضي الحساسة للضوضاء. ويمكن أن يؤدي التعرض للضوضاءإلى مجموعة من الآثار الضارة بما في ذلك اضطراب النوم والانزعاج، وضعف التعلم المعرفي لدى الأطفال في المدرسة، والاضطرابات النفسية، والآثار السلبية على الجهاز السمعي، والسمنة، وزيادة خطر الآثار القلبية الوعائية (8)، ولذلك الأسباب يمكن أن يكون تأثير الضوضاءأحد الاعتبارات المادية في تحديد تطبيقات التخطيط والتنمية المستدامة.إن الكثير من العوامل المرتبطة بالتخطيط الحضري لها تأثير كبير على حجم حركة المرور، وتوزيع المركبات، وظروف المرور، ومن المعروف أنه من الناحية الزمانية والمكانية فإن أهم مصدر للضوضاء في المدن هو حركة

المرور على الطرق (19). قدرت منظمة الصحة العالمية (WHO) عبء المرض الناجم عن الضوضاء المرتبطة بحركة المرور داخل الجزء الغربي من أوروبا وخلصت إلى أنه في كل عام هناك خسارة على الأقل مليون سنة من سنوات العمر المعدلة حسب الإعاقة(38). ويسعى التصميم الصوتي الجيد إلى تشجيع وتعزيز نتائج التصميم التي تتناسب مع كل موقع تطوير، وبالتالي فإن نظام التخطيط لديه مهمة توجيه التطوير إلى المواقع الأكثر ملاءمة.وسيكون من الصعب التوفيق بين بعض استخدامات الأراضي، مثل الإسكان أو المستشفيات أو المدارس، مع الأنشطة الأخرى التي تولد مستويات عالية من الضوضاء، ولكن يجب أن يضمن نظام التخطيط أن المشاريع الحساسة للضوضاء يجب أن تكون بعيدة عن مصادر الضوضاءالرئيسية (مثل الطرق والسكك الحديدية والنقل الجوي وبعض أنواع التنمية الصناعية)(22). الهدف الرئيسي من هذه الدراسة هو النهج المتعلق بحل مشكلة الضوضاء، فبدلاً من دراسة مواد وتقنيات عزل الصوت، فإنها تركز أكثر على التخطيط الحضري العام فيما يتعلق بشكل المباني واتجاهات الشوارع وإنشاء الحدائق الجديدة وإنشاء السدود الترابية والازدحام المروري للحد من تأثير الضوضاء على المواطنين خارج وداخل منازلهم. يمكن لخطط التنمية أن توفر إطار السياسة الذي يمكن من خلاله وزن هذه القضايا ويجب على سلطات التخطيط المحلية أن تدرس ما إذا كان من العملي التحكم في مستويات الضوضاء أو تقليلها من خلال استخدام التزامات التخطيط (21). قامت الدراسة البحثية بتحليل العلاقات بين الضوضاء الحضرية والجوانب المحددة المختلفة للتصميم الحضري من خلال منهجيات محددة لتقييم التلوث الضوضائي وعلاقته بالتخطيط الحضري. وبهذه الطريقة قد يكون العثور على مدينة مستدامة أقرب على الأقل فيما يتعلق بالتلوث الضوضائي. تم إجراء الدراسة على أغلب المناطق السكنية بمدينة القاهرة الجديدة. وقد أظهرت النتائج أن التخطيط الحضري يجب أن يتم مع بعض الاعتبارات المنطقية فيما يتعلق بآليات الانتشار والتضخيم السليمة من أجل تحسين راحة ورفاهية الناس في التطورات المستقبلية. تشمل الطرق المتبعة للحد من انتشار الضوضاء والتخطيط الحضري الجيد الحواجز منخفضة الارتفاع والمعالجات الأرضية؛ وواجهات وأسطح المباني وشكل المبنى وهدوء الجانب والغطاء النباتي. علاوة على ذلك تأخذ المعالجات في المصدر في الاعتبار احتكاك الإطارات وحالة الطريق والمحرك (سواء كان كهربائيًا أو احتراقًا)، وسرعة القيادة والتسارع والقيود الإضافية على المركبات التي تلعب دورًا مهمًا في تخفيف الضوضاء. يتم عرض التخفيضات الكمية في الديسيبل فضلا عن الجوانب النوعية. الاستنتاجات: إن التحسينات الموصوفة المحتملة للبيئة الصوتية الحضرية مع التركيز على ضوضاء حركة المرور على الطرق وتصميم المباني باعتبارها العوامل المعوقة السائدة، تخبرنا عن كيفية الوصول إلى بيئة سليمة حضرية جيدة. ومع ذلك للوصول إلى بيئة سليمة جيدة في الواقع فإن عملية عمل التخطيط السليم الحضري التطبيقي تتطلب بذل جهود عبر التخصصات في التخطيط في مرحلة مبكرة، بدلاً من التحكم التقليدي في الضوضاءالمطبق في وقت متأخر من عملية التخطيط.