The effect of the traffic noise on the environment comfort in the cities - Case study: Karada city in Baghdad

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Abstract. The noise pollution in the cities has become of great concern all over the World. This research deals with evaluating the noise levels that was carried out in the study area streets (Karada city). The aims of this research were to evaluate the environmental noise pollution present in Karada city caused by traffic noise, compare the measured noise levels in the city with legislations and to establish the connection between noise and the number of active vehicles. The research work was carried out in three different stages: The first stage dealt with the physical measurements (using Apparatus Device), while the second stage had to do with the field surveys and questionnaires conducted to measure and evaluate the effect of noise caused by vehicular movements in the main streets during traffic rush hours. The third stage was carried out in parallel with the first stage as the amount of traffic in the study area streets was measured. Ultimately, the research concludes with results and recommendations to protect the study area from traffic noise pollution, which in return would be very beneficial to studies that deal with planning a noise-free environment. Key words: environment; noise; pollution; streets; traffic noise.

1. Introduction
Noise has become a permanent and chronic problem in the major cities, especially with the very rapid increase in population of cities in recent years [1]. Despite the strategic importance of the transport sector of any country, but traffic is a major polluter of the environment and a major consumer of energy sources and a source of chain of problems that started to encounter the population of the city including the congestion, accidents, and environment pollution. The huge increase in traffic in cities has led to an increase in the level of the traffic noise, which is the first cause of environmental noise and represents about 60% of the causes of noise in some countries which is reflected on the health and lives of their inhabitants [2], led to the necessity of initiating new policies and programs concerned with urban planning in particular and giving more attention to the measurement of noise pollution and how to apply laws to reduce and control the effects of noise.

The city of Baghdad, in particular, the Karrada city suffers from severe congestion, especially in the morning and evening rush hours, perhaps due to multiple social, economic and security reasons. This affected the city system, especially with regard to noise pollution resulting from traffic on the main roads, which is a major source of environmental pollution. Hence the problem of research is that the city of Baghdad suffers from noise pollution caused by the means of transport and the consequent health and negative damage on its members, which calls for the development of ways to mitigate its effects. The research assumes that the city of Baghdad is exposed to noise pollution resulting from the movement of various modes of transport as a result of various human activities in it. The aim of the research was to study the pollution of traffic noise of the city of Karrada in Baghdad and its effects on humans and to...
measure indicators and factors important in the process of pollution resulting from traffic congestion, and the possibility of adopting new planning policies to reduce traffic delays due to congestion adversely affecting the flow of roads movement to reduce and control the effects of noise and elimination.

2. Environmental pollution and traffic noise

Noise is defined as the sound that people are unwilling to hear or receive and which causes harm to them [3], especially the high level of noise that requires concentrating efforts to reduce its negative effects and protect human and society from its dangers and damages. The output of road traffic within the city is one of the causes of noise, especially near important roads with high traffic volume in any major city especially in developing countries where roads are in poor condition, and have a large number of vehicles depends on outdated technology and poor maintenance, so presumably, it is important to give priority to the traffic noise [2] that is considered to be a major problem in cities, especially small cities, which are penetrated by major roads with heavy traffic, which makes the living environment of the people in these cities deteriorating. Due to the importance of noise and reducing its effects, most environmental noise research centers are concerned with the number of cars, their quality, its engines and fuel used, as well as the age of the car itself, and the level of serviceability of the streets, including the level and dimension and other factors affecting the proportion of traffic noise and increase [4]. Therefore, it is necessary to pay attention to reducing or minimizing the various sources of noise, especially the noise generated by the movement of vehicles, which is one of the biggest contaminants of the environment and is increasing.

3. Sources of traffic noise and its negative effects

Traffic noise depends on the interaction between six major factors (traffic volume, traffic composition, road speed, vehicle noise, road grade, and road surface), which influence and interfere with increasing noise levels. These factors influence and interfere with increasing noise levels [3]. Mostly, the car's engine affects the transmission of noise and increases the noise level during acceleration, and the surface reaction of the road and tires is a major generator of noise resulting from movement on the concrete surface. In the case of a smooth road surface, it usually produces less noise than the rough surface. Poorly maintained roads with holes may cause greater noise. Noise caused by the movement of different parts of the vehicle includes the engine exhaust inlet, gears, brakes and body structure (chassis), loading in the car, shutting the door, etc. As the vehicle gets older, its mechanical condition deteriorates the more noise it produces, as well as the noise from motorcycles, scooters and minibuses [2].

The increase in the level of traffic noise affects the human and in general the impact is more psychological than physical on human health and activity, and if the noise amounts to the inconvenience, this adversely affects the public health and the brain cells and the auditory and nervous system and the inconvenience hinders healing and it puts patients' lives at risk and the noise level exceeding 75 dB (A) causes narrowing of blood vessels and thus increases blood pressure and affects the respiratory system [5]. At the level of work and productivity, the effects of noise pollution was reflected on the productivity of companies, one of the companies added insulation material on the walls to absorb sound, which led to a decrease in accounting errors by about 25%, as well as typing by 27%. The world health organization confirmed that noise at home or school affects children's ability to learn. For example, children living near the airport found to have higher blood pressure than school children away from the airport had achieved lower rates of reading and delayed in developing language abilities and fatigue and poor school performance in general with increasing hostility and lack of cooperation and poor cooperation [6].

4. Controlling the intensity of traffic noise

Traffic noise intensity can be controlled through the following points:

- Noise control (vehicle): Noise reduction is achieved by making improvements to the main parts of noise such as the engine and cooling fan and selecting the appropriate size and quality of the exhaust silencer pipe that has a significant impact on reducing the vehicle's noise, as well as choosing the appropriate quality of tires that come into contact with the road surface and generate noise [7].
• Road design and furnishing: Noise levels are controlled and reduced by placing certain limiters along the road that reduce or eliminate noise from access to buildings overlooking the road. Trees, different filters and barriers on the road significantly reduce noise as well as the quality of the road section (its height, shoulders, and surroundings) affect the style and extent of sound transmission as higher roads from neighbourhoods usually transmit sound more to the surrounding area, unlike low roads surrounded by high shoulders that isolate them from the surrounding and help absorb most of the noise [4].

• Land-use planning: as planning and regulation of land use and grading of roads from the main and secondary contribute to reduce the intensity of noise affecting buildings and residential areas [7] Perhaps the solution of the comprehensive formula is one of the best ways to reduce noise and its negative effects on the urban population, as well as reduce noise, such solutions reduce the vibrations caused by traffic and cause damage to buildings overlooking the road [3]. The planning proposals for highway Bypass come as an organizational solution that avoids the city's passage and contributes to maintaining calm in the city center and reduce noise and vibrations affecting the population and buildings with the presence of some traditional buildings, especially the old buildings in the centers of some cities that may be adversely affected by the passage of vehicles, especially heavy vehicles near them[1].

5. Permissible Noise Intensity (Noise Intensity Standards)
The permissible criteria for noise intensity may vary from country to country depending on climatic, spatial as well as cultural factors [8] (Table 1), tables (2) and (3) illustrate the types of noise, its degree and its problems.

| Table 1. Permissible Noise Intensity (Noise Intensity Standards) [8] |
|--------------------------|----------|----------|
| Usage type              | Day      | Night    |
| Residential areas       | 60       | 50       |
| City Center             | 65       | 60       |
| Industrial areas        | 75       | 65       |
| Other uses              | 70       | 65       |

| Table 2. Types of noise and degrees with examples (Researchers based on [9]) |
|--------------------------|----------|----------|
| No.                      | Noise type | Intensity in decibel | Example |
| 1. Heard                 |           | 0-10     | Heartbeat (10) |
| 2. Very quiet            |           | 10-30    | Swish trees (20) |
| 3. Quiet                 |           | 30-50    | writing machine (printer) (40) |
| 4. Medium loud           |           | 50-70    | air conditioner (65) |
| 5. Very loud             |           | 75-100   | Traffic noise (90) |
| 6. Inconvenient noise    |           | 100-130  | Jet plane (103) |
| 7. Very dangerous        |           | 200-     | Rocket (200) |

| Table 3. Noise levels negatively affecting human (Researchers based on [9]) |
|--------------------------|----------|----------|
| No. Noise intensity      | Negative effect on human |
| in decibel               |                        |
| 1. 40-50                 | Anxiety and psychological discomfort |
| 2. 60-80                 | Affects the nervous system and causes severe pain in the head and decreases the ability to work |
| 3. 90-110                | Reduced hearing ability and causes disorders in the nervous system and the cardio system |
| 4. 120-                  | Pains in the hearing system and severe effects on the cardio system and causes inability to distinguish voices and its directions. |
6. Practical study Material and Methods

6.1. Tools materials

6.1.1. Sound level meter. Traffic intensity noise is estimated using (the Digital Sound level Meter Tes) in accordance with the 2013 IEC Standards of the International Electrotechnical Commission (IEC). The volume meter is installed 1 meter from the building, and during the measurement the microphone should be directed to receive the clearest measurement possible, and the sound measurement device shall be in the Quick Response mode (A). This method is characterized by measuring the intensity of total noise pollution generated by all motor variables within cities that generate loud sound from the movement of people, factories, generators, traffic.

6.1.2. Surveys. As follows:

Surveys of traffic volumes: The traffic noise intensity is calculated based on the volume of traffic in the morning and evening peak hours, where the following mathematical equation was adopted [10]

\[ L_{eq} = 23.7 \times \log M \]

Whereas: Leq is roadside equivalent noise level (db), and M is an average daily vehicle numbers (vehicles per hour).

Land usage survey: The main land uses and services provided in the study area are studied.

6.2. Practical aspects

6.2.1. Study area. Baghdad is one of the largest metropolitan cities, with an area of 843.42 km² (Baghdad Municipality Design Department: Geographic Information Division), and a population of approximately (7.6) million people [11]. The land is distributed among residential, commercial, industrial, service and recreational areas, and has regional relations with the various governorates of the country. As a result, the number of registered vehicles has increased to more than 1300000, although its streets are designed to accommodate fewer vehicles [12]. As well as the impact of increasing population density on the increase in the number of vehicles, so our study will be limited to one side of the municipality of Karrada, which represents the northeastern part of the municipality of Karrada, located in the city of Baghdad, where an area of about (24.6 km²), and the proportion 34% of the total area of Karrada Municipality (71.6 km²) (fig. 1) [12] as it is one of the important centers of the city of Baghdad.

![Figure 1. The study area within Baghdad area (Researchers based on [12], using ARCMAP (VER10.2)/ (2016))](image)

6.2.2. Physical measurement. Field surveys were conducted for several points located in the study area near the main roads and streets using a noise intensity-measuring device. The surveys were in the
morning and evening peak times. The results were recorded and arranged in tables and then compared with the pollution rates measured by the movement of vehicles.

6.2.3. Survey.

Land use survey: The study area is characterized by a variety of land uses, including educational (University of Technology complex including educational facilities, laboratories and a private university in the specialty of pharmacy), and uses of land for health services (Alawiya Children's Hospital, Alawiya Maternity Hospital, Al Wasiti Hospital), and uses of commercial lands (Al-Sinaa Street) specialized in computer trade and accessories, as well as industrial uses (various industries, most important vehicle repairs), and the proliferation of many ovens and bakery pastries and sweets, as well as the presence of the main bus terminals of public transport lines and the petrol station, as well as residential use (Zeyouna).

Traffic volumes survey: The survey was conducted for the period (November 2017 - May 2018) and for the morning and peak periods (8-10 am) and evening (1-3 pm) to determine the levels of noise pollution resulting from traffic. The statistics of traffic volumes surveys were conducted for all roads leading to intersections and squares within the study area by traffic counting. The results were arranged in tables showing the results of traffic volumes with classification of mode of transport from large, medium and small, and all types of vehicles were converted equivalent to a small vehicle by using the PCU conversion factor (Table 4).

| No. | Vehicle type | PCU  |
|-----|--------------|------|
| 1.  | Bicycle      | 0.33 |
| 2.  | Motor cycle  | 0.75 |
| 3.  | Small vehicle| 1.00 |
| 4.  | Small bus    | 1.50 |
| 5.  | Small truck  | 1.75 |
| 6.  | Big truck    | 2.50 |
| 7.  | Big bus      | 3.00 |

According to the classification of urban roads, which depends on the volume and quality of the expected traffic on the roads, the average length of the journey served by the road, and the location of the road relative to the adjacent roads in the network (Table 5) [13], the status of transportation system in the study area by conducting field surveys of transport networks to classify the types of roads, the most important intersections and squares within the study area, and compare the results and audit them with the concerned departments [12], where the city of Karrada is surrounded on two sides by the highway Mohammed Al-Qasim from the south and north-east, which is a major outlet between Baghdad and the central and southern provinces and there are four direct entrances from the highway of the city of Karrada is (the entrance of the two-story bridge, the entrance to the camp Rashid, and the entrance of Camp Sarah, and the entrance of Andalus Square) in addition to the entrance of the Al-Jadriyah bridge and the entrance to the Al-Bab Al-Sharqi, which is more vital and with more traffic, and the city of Karrada is one of the important commercial cities and also has Industrial factories, offices and private companies, as well as shopping shops and restaurants, as well as the presence of the University of Baghdad and the University of Technology in the city makes it a point of population attraction as well as private colleges (College of Israa, College of Uruk, and College of Al-Bayan, etc.) These reasons make the city in a state of extreme noise because of the intensity of the population and vehicles and lack or narrow streets, where the main streets of the city are (Saadoun Street, Karrada Dakhel Street, Al-Nidhal Street, Al-Sinaa Street, Karrada Kharej Street, Abu Nawas Street) and other streets. Karrada city also includes several traffic intersections, including (Andalus Square intersection, Kahramana Square intersection, National Theater intersection, Qoba Bin Nafea Square intersection, Al-Masbah intersection, Al-Arsat intersection, Al-Watheq intersection and others) (Table 6).
Table 5. Classification of urban streets [13]

| Category   | Type       | Designed speed km/hour |
|------------|------------|------------------------|
| Free       | Divided    | 90 or more             |
| Main       | Divided    | 70-90                  |
|            | Un-divided | 60-80                  |
| Sub-road   | Divided    | 50-70                  |
|            | Un-divided | 40-60                  |
| Local      | Un-divided | Less than or equals 50 |

Figure 2. The streets of the study area and their classifications (Researchers based on [12], using ARCMAP (VER10.2)/ (2016))

Table 6. Classification of main streets within study area (Researchers based on [12])

| Street Name          | location                                                                 | No. | type | Length a m |
|----------------------|--------------------------------------------------------------------------|-----|------|------------|
| Khalid bin Walid     | From Al Ghadeer Bridge to Al Jadirya Bridge                               |     |      |            |
|                      | A. From Al-Ghadeer Bridge to Oqba Bin Nafie Intersection with the number (16) passing through the neighbourhoods (906) and (908). | 16  | TS-O1 | 16240      |
|                      | B. From the intersection of Uqba Bin Nafie to Jadriyah Bridge bearing the number (18), passing through neighbourhoods (923), (913), (925), (909), (929), (905), (903) | 18  |      |            |
| Khawla bint Al-Azwar | 14th Street from Al-Rubaie Bridge to Abu Nawas Street through neighbourhoods: (904,902,903,901) | 14  | TS-O1 | 4518       |
| Street 10            | From Al Shaab Stadium Bridge to Kahranama Intersection, passing neighbourhood (902) | 10  | TS-O1 | 2823       |
AL-SINAA Street  From the intersection of Wasiti Hospital to the intersection of 33 
Khalid bin Walid 
A. From the intersection of Al-Wasti Hospital to the 
intersection of Khawla bint Al-Azwar Street holds the alley 
no. (33). 
B. From the intersection of Khawla bint Al-Azwar to the 
intersection of the University of Technology alley (30) 
C. From the intersection of the University of Technology to 
the intersection of Khalid bin Walid, and holds the 
number (21) 

Mohammed Al Qasim Street  Highway from the bridge of the AL-SHAAB Stadium to the 
camp Rashid outlet 
Street 21 neigh. 910 From Mahala (910) intersection of Khalid bin Walid, until the 
beginning of the alley of Camp Sarah through Mahalla (911) 
Street 65 neigh. 910 Alley (65) locality (910) (Kamp Sarah) 
Street 18 neigh. 906 Street (18) Mahala (906) from the AL-SINAA street, and until 
Abdulkader Algazarei Square 
Al-Attar Street  Al-Attar Street locality (905) / alley (11) from Karada Street 
inside to Karrada Street outside 
Street 26 neigh. 913 Street (26) Mahala (913) From Khalid Bin Al Waleed Street to 
29th Street (Mahala 913). 

Total street lengths 44740

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7. Results and discussion

7.1. Physical measurement

| The road | Ratio of pollution measured by the device | Morning | Evening |
|----------|------------------------------------------|---------|---------|
| From the pedestrian bridge (Mohammed Al-Qasim) to the intersection of Al- Bab Al-Sharqi | 71 | 121 |
| Mohammed al-Qasim from the intersection of Al-Bab Al-Sharqi to the bridge of Ghadeer | 71 | 121 |
| The intersection of Zayouna (Mohammed Al-Akasem) from Al-Ghadeer Bridge to Al-Bab Al-Sharqi intersection | 68 | 111 |
| From the intersection of the Al-Bab Al-Sharqi to the bridge of Ghadeer | 68 | 111 |
| From the intersection of Zayouna Bridge to the intersection of Al-Wasti Hospital | 70 | 123 |
| From the intersection of Zayouna Bridge to the University of Technology Square in two 78directions | 83 | 123 |
| From Al-Shaab Stadium Bridge outlet to the Passport Intersection in both directions | 88 | 118 |
| From Zayouna Bridge outlet + Road from Mohammed Al Qasim to the intersection of Zayouna Bridge in two directions | 88 | 129 |
| From the intersection of Zayouna Bridge to Al-Wathq Square in two directions | 88 | 120 |

7.2. Noise intensity using traffic volume survey

**Table 8.** Traffic volumes in the highway near the pedestrian bridge (Mohammed Al-Qasim) from (8- 
10) am

| Vehicle direction | Small vehicle | Small fair vehicle | Bus 18 passengers | Bus 48 passengers | Truck | Truck | Motor cycle | Bicycle |
|-------------------|--------------|--------------------|-------------------|-------------------|-------|-------|------------|---------|

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^a All street lengths are taken on both sides of the road (back and forth)^
^b TS-O1: Main arterial street.^
^c TSF: Free streets.
Towards AL-Shaab stadium
In the other direction

| Vehicle direction | Small vehicle | Small fair vehicle | Bus 18 passengers | Bus 48 passengers | Truck | Truck | Motor cycle | Bicycle |
|-------------------|---------------|--------------------|-------------------|-------------------|-------|-------|-------------|---------|
| Towards AL-Shaab stadium | 356 | 512 | 181 | -- | 96 | 63 | 23 | -- |
| In the other direction | 266 | 425 | 94 | -- | 104 | 47 | 8 | -- |

Table 9. Traffic volumes in the highway near the pedestrian bridge (Mohammed Al-Qasim) from (1-3) pm [Researchers based on field survey results]

| The road | Traffic volume vhp | Percentage of total pollution resulting from Leq= 23.7*Log (M). |
|----------|-------------------|---------------------------------------------|
| From the pedestrian bridge (Mohammed Al-Qasim) to the intersection of the Al - Bab Al-Sharqi bridge. | 1038.74 | 72.00 | 75.00 |
| Mohammed Al – Qasim from Al-Bab Al-Sharqi intersection to the bridge of Ghadeer | 1203.66 | 73.00 | 73.00 |
| Zayouna intersection (Mohammed Al-Akasem) from Al-Ghaider Bridge to Al-Bab Al-Sharqi intersection | 1033.25 | 72.00 | 70.00 |
| The intersection of the Al-Bab Al-Sharqi to Al-Ghaider bridge | 1508.25 | 76.00 | 73.00 |
| The intersection of Zayouna Bridge to the intersection of Al Wasti Hospital | 1920.00 | 78.00 | 77.00 |
| From the intersection of Zayouna Bridge to the University of Technology Square in two directions | 3120.00 | 83.00 | 80.00 |
| From the bridge of the AL-SHAAB Stadium bridge to the intersection of passports in both directions | 3600.00 | 84.00 | 89.00 |
| from the end of the bridge Zayouna + road from Mohammed Qasim to the intersection of Zayouna bridge and two directions | 2940.00 | 82.00 | 89.00 |
| From the intersection of Zayouna Bridge to Al - Watheq Square in two directions | 3600.00 | 84.00 | 81.00 |
Table 11. Noise pollution ratio measured by volume of vehicles to pollution measured using noise measurement device.

| The road                                                                 | Percentage of total pollution resulting from vehicle traffic | Noise pollution ratio measured by the device | Noise pollution ratio from vehicles movement per the pollution percentage measured by the device |
|--------------------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------|
| Morning Evening                                                          | Morning Evening                                             | Morning Evening                             | Highest pollution ratio                                                                         |
| 1. From the pedestrian bridge (Mohammed Al-Qasim) to the intersection of the Al-Bab Al-Sharqi bridge. | 72.00 75.00                                                 | 71 121                                      | 62                                                                                              |
| 2. Mohammed Al – Qasim from Al - Bab Al - Sharqi intersection to the bridge of Ghadeer | 73.00 73.00                                                 | 71 121                                      | 60                                                                                              |
| 3. Zayouna intersection (Mohammed Al-Akasem) from Al-Ghadeer Bridge to Al-Bab Al- Sharqi intersection | 72.00 70.00                                                 | 68 111                                      | 63                                                                                              |
| 4. From the intersection of the Al-Bab Al-Sharqi to Al - Ghadeer bridge   | 76.00 73.00                                                 | 68 111                                      | 66                                                                                              |
| 5. From the intersection of Zayouna Bridge to the intersection of Al Wasti Hospital | 78.00 77.00                                                 | 70 123                                      | 63                                                                                              |
| 6. From the intersection of Zayouna Bridge to the University of Technology Square in two directions | 83.00 80.00                                                 | 83 123                                      | 65                                                                                              |
| 7. From the bridge of the AL-SHAAB Stadium bridge to the intersection of passports in both directions | 84.00 89.00                                                 | 78 118                                      | 76                                                                                              |
| 8. from the end of the bridge Zayouna + road from Mohammed Qasim to the intersection of Zayouna bridge and two directions | 82.00 89.00                                                 | 88 120                                      | 69                                                                                              |
| 9. From the intersection of Zayouna Bridge to Al - Watheq Square in two directions | 84.00 81.00                                                 | 88 120                                      | 68                                                                                              |
Tables (8) and (9) present a sample of traffic volume surveys in the study area during the morning and evening peak periods. Table (10) shows the results of traffic volumes equivalent to a small vehicle by using the PCU conversion factor, for morning and evening peak periods, and the noise pollution intensity using the mathematical equation \( L_{eq} = 23.7 \times \log (M) \). In Table (11) the traffic noise ratios were compared based on traffic volumes in the morning and evening peak periods with the results of the total pollution of the study area, which was measured using the noise pollution determination device. It was found that the traffic noise levels in some places amounted to approximately 90% of total noise pollution, and that the lowest percentage of traffic noise is not less than 50% of total pollution.

When comparing the noise pollution measured by the device of the study area with the criteria (Table 1), we find that the area is between a residential area and an area close to the city center, where the main roads linking the city center with the Mohammed Al Qasim highway and the opposite road of the university of technology passing through Al Alwiya Hospital to the intersection of outlet Al Shaab Stadium Bridge which connects to the road leading to Bab Al Sharqi area (city center). In general, all the results of the noise pollution calculated were higher than (60), only an area near the level (60) where it recorded (68) dB which represents the lowest reading ever acquired during the day within several readings where the ratio of pollution to the lowest reading recorded near the intersection of Bridge AL-GHADEER (Mohammad Alkasem) to the intersection of the ALBAB ALSHARQI. The highest reading was recorded in the area near the intersection of Zayouna Bridge to Al-Wathiq Square and in two directions where the reading was (129) dB. As a result, it was concluded that the area suffers from noise pollution. Then, the level of noise pollution resulting from traffic volumes was determined in the roads within the study area. Traffic surveys of roads were carried out during the morning and evening peak periods.
hours and the volume of vehicles was determined in the roads. The highest traffic volume was recorded in the roads leading to the outlet of Zayoonah Bridge where the highest traffic volume reached 5700 vehicles per hour, the results of traffic volume surveys have been included in the special formula to measure the percentage of pollution produced based on the traffic volume and finding the results. The highest pollution ratios were because of traffic compared to the criteria is in the road leading to the Zayouna bridge outlet+the road of Muhammad al-Qasim to the Ziyouna bridge intersection+ bridge road from Muhammad al-Qasim to the intersection of Ziyouna bridge in two direction where the contamination ratios reached 89 dB. It is the road with the highest traffic volume ratios and also the highest noise pollution by using noise intensity checking devices. Finally, the results of total noise pollution were compared using the total pollution measurement device in the study area with the pollution resulting from the movement of vehicles, which was calculated based on traffic volume surveys in the morning and evening peak hours. A table was made that shows ratios of comparison between the results as shown in table no.11, when comparing the results with the final percentages of noise pollution resulting from the traffic on the roads with the total noise pollution that was counted when conducting field surveys, it was found that the percentage constitutes about (60-76)% at various monitoring points within the study area that were chosen near the main and secondary roads and this difference was due to the location of the road and the volume of traffic momentum as well as depends on it and also the type of services and activities in the study area, especially those services and activities that constitute a large proportion of noise pollution in the study area, especially those services and activities that presents high ratio of the noise pollution in the study area and as a result it was concluded that more than 60% of the noise pollution within the study area is due to congestion and movement of vehicles in the roads within the area.

8. Conclusions

There are many sources of noise in the province of Baghdad in terms of their modes of transport in the ground, including cars, motorcycles and railways, the noise from which ranges from the levels of medium to very disturbing, while air transport in them fall into the category of painful noise. As well as professional noise from factories and blacksmiths and trade in the city, which falls within the category of very annoying and painful, as well as noise from hospitals and from the neighbourhood, which falls within the noise of the medium and very annoying. Also, Traffic noise constitutes a large percentage of total noise in the study area, where the traffic noise ratios in some places amounted to approximately 90% of total noise pollution, and that the minimum percentage of traffic noise is not less than 50% of the total pollution.

According to the multiple sources of noise pollution in the province of Baghdad-Karrada area it is noted that it exceeds the acceptable levels of noise according to the standard of the World Health Organization. Due to the high concentration of government, commercial and service activities in the study area, the main streets that pour into the area caused severe pressure on the area, resulting in severe traffic problems: unexpected traffic congestion and stoppages, and the random parking of vehicles on both sides of the street, which impedes Traffic and increases congestion, and the presence of the movement of vehicles with large weights of trucks to transport goods and various products. Therefore, the increase in the number of vehicles and the lack of roads that lead to congestion and the latter is a major cause of traffic noise.

9. Recommendations

Work on the organization and management of traffic in roads and streets, which leads to reduce the problems of transport and traffic to avoid traffic jams and accidents on the road network, where it is considered the most important goal of reducing traffic noise.

The use of acoustic barriers and plants to protect sensitive activities from noise, the separating areas between and the road should be planted with green palms and evergreen trees, where the grass works to absorb noise and help trees to disperse it, in order to be absorbed, it must be evergreen and of great depth. Where a protection zone is defined at a depth of about 100 meters, the amount of reduction is up to 20 dB(A), if left uncultivated, but when planted with evergreen trees at a height of about 6 meters, the amount of decrease is up to 40 dB(A). If there is no plant protection area due to the lack of sufficient
land, as in the area adjacent to the highway of Mohammed Qasim, to reduce noise in urban areas adjacent to the road it is resorted to the establishment of sound barriers.

Reduce as much as possible the presence of intersections and traffic lights in the residential area and take advantage of closed streets to calm the passage of cars and thus reduce traffic noise.

It can be resorted to cover some sources of noise (roads and streets) in urban communities already existing and reached a point such that it is difficult to deal with the problem through the procedures and applications mentioned earlier, and there are three forms of road coverage can be implemented to reduce traffic noise, namely the open tunnel, closed tunnel, The misleading tunnel which reduces the noise level at the surface by 20 dB(A) according to the height of the tunnel wall, which functions as if it were an acoustic barrier. It can be implemented in the city of Karrada at the intersection of Andalus Square and the intersection of the Al-Masbah and the intersection of the University of Baghdad.

Work on the collection of similar services in one place in the city such as university buildings and associated departments, and the removal of factories, workshops, hospitals and restaurants and identify specific places, to reduce excessive trips.

The application of the urban legislation of the region is an attempt to reduce noise in the long run, as well as laws on noise and traffic (is an attempt in the short term) and commitment to apply them from local authorities. Also, adopting modern planning studies, which emphasize the sustainable development and preservation of the environment to reduce the effects of noise. So in the newly constructed buildings, the design of self-protection buildings is used where parts with acoustic shade areas are used to open windows and doors.

The cities should be surrounded by a green belt with dense trees, multiplying parks, keeping houses away from roads and using protective barriers, as well as taking advantage of different elevation levels to decide the roads and housing location.

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