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Application of traffic noise map at the University of Mosul, main campus

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Abstract: The University of Mosul is enclosed by a network of streets with high traffic flow. It also has an internal road system. The campus is consequently exposed to several kinds of noise. On the campus, thousands of students and employees are clearly impacted by traffic (and other sources of noise). With reference to the local road system, this study attempts to quantify the noise levels at certain locations on the campus. With the use of a GIS framework, the data were processed and mapped. Contouring and interpolation techniques have been used to view the spatial distribution of noise intensity.
Keywords: Noise pollution, University of Mosul, traffic noise, mapping, civil engineering

INTRODUCTION

Streets are the heartbeat of our neighborhoods and the foundation of our urban economy. As well as being able to deal with traffic, these structures must also be sturdy and safe. A design strategy that takes into account the many functions streets play in our communities is essential for urban life's dynamism. The importance of transportation and investment in urban and economic growth has been stressed in numerous studies (Thondoo, et al. 2020). The engineering and traffic characteristics of the road network reflect civilization and modernity.

Most educational campus plans include an emphasis on maintaining a high-quality environment for students and personnel in order to compete with other local and global universities. While it may be common knowledge, many firms place a high value on driving rather than walking. Other institutions, on the other hand, have emphasized the value of having a pedestrian network to link various academic interests.

In order to improve circulation on university campuses, the most sustainable solution is to improve public transit. Because traffic is a gauge of how heavily a route is utilized, it provides useful insight into the needs of the people who use it. It is necessary to employ three key traffic flow parameters to determine street service levels: flow rate, speed and density. In the Iraqi city of Mosul, Mosul University is a government-run institution of higher education. The university was established in 1967. University of Mosul (UOM), like many others in Iraq and around the world, aims to present their commitment to ethical and professional values, a stimulating environment for education and intellectual creativity, support for human rights, optimal use of technology and creative research that helps build a knowledge society. A substantial impact has been and will continue to be made on city life by the University of Mosul community. With 24 colleges, 6 research institutes, 7 consulting offices and 5 hospitals and clinics on three campuses, the university has a wide range of resources at its disposal.

More than 50 thousand people make up the UOM community, which is made up of students, instructors, staff, and other University regulars (daily visitors, contractors, vendors, and any employee of an official or government agency located on campus). The estimated size of the UOM is 200 hectares. It was decided in 1989 to perform a study titled "Recommended Traffic and Parking Program for UOM" with the aim of improving traffic operations and reducing parking problems while also increasing safety for both motorists and pedestrians. According to university criteria for expected traffic and parking needs, this idea was developed to accommodate those demands as well as campus regulations. To deal with specific and temporary traffic and parking issues on the main campus caused by a variety of factors like changes in the Campus master plan, security requirements or emergency conditions in vehicle and pedestrian movement, numerous studies, small projects and unpublished research were conducted between 2000 and 2019.

Urban noise pollution adversely affects quality of life and public health. New policies to address urban noise pollution are likely to be implemented in many developing countries, regardless of their participation in any explicit future noise pollution policies. Noise pollution, like air pollution, is becoming a growing concern in an increasing

number of megacities around the world. As the number of people and automobiles in cities rises, so does the level of noise pollution and other quality of life issues, which are often closely linked due to common generating mechanisms (Birglund et al. 1999). Noise pollution is a result of contemporary technology and metropolitan growth, and it has increased dramatically in recent decades. Noise pollution also affects the health of individuals as well as the general public. According to the World Health Organization, noise pollution has been related to seven main types of negative health effects on humans.

Mucci et al. 2020 indicated in their research that noise pollution can result in a range of health issues, including hearing loss, difficulty in understanding spoken communication, difficulty in sleeping, cardiovascular issues, mental health issues, and irritation ((CCOHS), 2011). The majority of the aforementioned issues may have an effect on academic research and instruction in universities. The study's findings showed that students who were subjected to noise pollution while studying had higher resting blood pressure, more stress, and slower reading speeds. As a result, pupils who reside in noisy environments may experience difficulties with reading and speaking.

Consequently, to improve human health, it is necessary to examine the causes of noise and manage noise intensity in a learning environment. The University is a noisy place due to the enormous number of students, machinery, cars, and electric generators. A good way to reduce noise pollution is to improve educational facilities or relocate universities outside of town. University of Sulaimani's previous campus was subjected to a noise pollution according to an investigation in December 2011 (Rauf KM et al, 2015). Using a 43-130 dB digital noise dosimeter, this research shows how much noise pollution there is in educational settings. Overall, the research was conducted in 25 distinct locations across the university campus, including hallways between classes at various levels in five colleges and another three locations.

However, in the study year of 2013, the level of noise pollution was examined in three different locations on the old and new campus. There have also been complaints of noise pollution at three different sites throughout campus. Various days in December 2013 were used to measure the old and new Sulaimani campuses with the same instrument and compare them to the same three places that were taken two years earlier.

The noise produced by recreational activities, as well as noise emissions from labs, power generators, and other sources, can all be found on a university campus. According to most studies on noise pollution, noise has a negative impact on tasks like communication and focus, especially in educational settings like schools, educational laboratories, colleges, and universities. According to studies on noise levels on different campuses, traffic is the main cause of noise (Ibrahim S., 2014). . As specified by Balila and Siddiqi (1999), noise levels at the Saudi Arabian Faculty of Engineering were greater than the ideal noise requirement of 55 dB. This was caused by how close to busy roadways the school situated.

The national highway that runs through India's Guwahati University is a major source of noise pollution on campus, according to the university. The morning, noon, and evening noise levels were found to be between 10 and 11.2 dBA above the quiet area category's specified noise limitations set by the Central Pollution Control Board (Phukan & Kalita,2013).

Atatürk University in Turkey was plagued by road noise as well. According to the Turkish Environmental Determinants, noise levels at several locations exceeded the permitted value of 55 dBA (Ozer et al, 2014). According to the study, several types, including transportation, industry and individuals, caused higher noise levels.

Electrical generators, pumps, automobile horns, welding and lathe equipment in the general workplace, and ambient noise from bus stops were among the noise sources discovered by Olaosun and Ogundiran (2014). It was determined that noise levels exceeded 85 decibels in most loud outdoor places near the main noise sources on the University of Ibadan campus, with the highest values reaching 112 decibels near the electrical generator.

Noise mapping is the most straightforward method for determining how outdoor noise levels fluctuate from location to location (Peters et al, 2011). For noise mapping, you need to know the study area, the noise sources (like traffic and construction), the

number of people who are exposed (called receivers), the topography of the area, as well as the weather conditions. You can then measure the equivalent A-weighted sound pressure level and sound power level in decibels (dBA) in that area (ISO-2,1996; DIN45682,2002; WG-AEN,2007). To deal with large areas of noise, noise mapping is used. Noise mapping also identifies the most bothersome sources of noise on campus.

Traffic noise analysis and prediction models are useful tools for creating environmentally friendly highways and assessing the impact of noise reduction initiatives. Traditionally, exposure to road traffic noise is evaluated solely for specific areas such as schools, campuses, hospitals, and airports. Road traffic noise is one of the most common and developing environmental issues on college campuses. Noise is often neglected as a pollutant since it is widespread, has no chemical harm, and has no traceable fatality. The consequences of traffic noise on people's health are varied and might include psychological, physiological, and social consequences. (Stansfeld, S.et al, 2021).

In many countries, noise mapping has been recognized as an important document in noise impact evaluations for university campuses and other educational locations. With the use of a GIS framework, noise mapping was conducted at the university of Kofa (Hussein and Sultani, 2021) the data were processed and spatially analyzed using GIS approaches. Contouring and interpolation techniques have been used to monitor the spatial distribution of noise intensity. In certain locations of the University of Mosul main campus, noise during peak traffic hours has grown to be a substantial source of environmental pollution, with negative impacts on its community. Accordingly, this study aims to:

1. Describe, assess, and evaluate the current noise level pattern at the UOM.

3. Discuss a possible appropriate solution with recommendations based on the requirements and aspirations of the UOM community, which will help reduce traffic noise and effects for all modes of transportation in the study regions.

THE STUDY AREA

This study was conducted in the premises of the University of Mosul main campus. See figure (1). The area extends over 1 X 2 km. Most of the university area is located in a hilly terrain that range in elevation between 220 – 270 m.

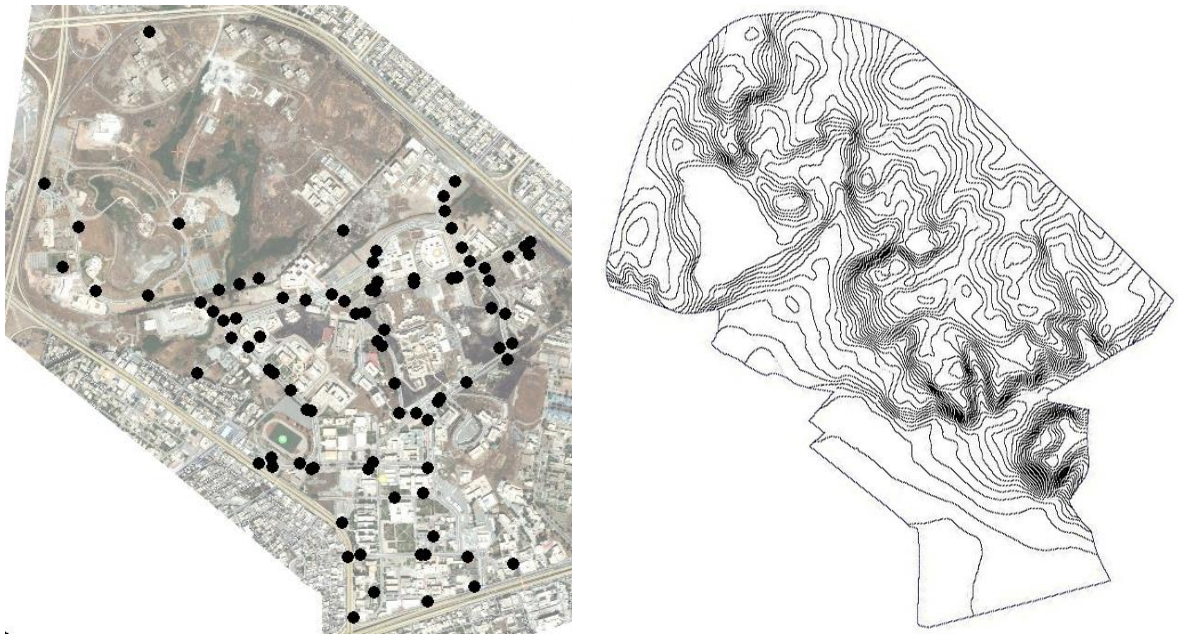


Figure 1- The study area: Topography and locations of noise measurements

Four major arterial roadways, each of which is classed as a split multi-lane highway, surround the

UOM. These roads run parallel to the main campus's exterior limits and comprise its outer perimeter. These roadways intersect at three main interchanges near the university as shown in Figure 2. Each of these streets is a major arterial street in the city's road network, connecting several portions and large areas of the city in various directions and providing access to residential districts it passes through. Streets are both a functional and pivotal feature as well as an economic asset. Internal University roads are distributed to serve various academic departments. More roads are found at the older (southern parts) congested university agglomerations.

Materials and methods

Noise measurements have been recorded using the precision sound meter type 2232 from Bruel and Kjaer. Figure 2. A tool for conducting community and industrial noise surveys. The meter is strong and lightweight (460 gm), making it ideal for environmental health inspections to monitor permissible noise levels in industrial and residential settings. Its main components comprise a microphone, amplifier and a display. B&K 2232 has range of measurement in between 34 dB to 130 dB, this range is divided in two sub ranges 34 to 94 dB and 70 to 130 dB.

Figure 2. The B&K sound meter.

Interpolation tools were used to process all the collected data to create contour maps and 3d views. Interpolation was performed using the kriging methods which keeps the original reading values unchanged.

At each station point, the instrument was set and the noise recorded together with the GPS location. More than 90 points were occupied along main streets all within the main campus area. More dense at older built up university premises. All collected locations have been transformed into UTM coordinate system. At each location, three noise measurements were recorded. i.e. at 1 m, 5 m , and 10 m from the street.

Other sources of data include site visits, personal observations, measurements, imaging techniques were all employed to obtain the necessary information for this study's aims. As needed by the study, data collection also includes an examination of available data and documents at the relevant university departments. Reliable data gathering technology and analytical tools can help monitor performance more effectively and quickly. The manual observation method was utilized in this study (manual traffic count data collection in the field or through film).

INVESTIGATED ISSUES

A common feature in the rapidly developing urbanization around and within the UOM is the escalation of traffic and parking issues. Without an accessible, holistic, sustainable, and developable solution, the challenges faced by the main campus with traffic concerns on their streets (both inside and outside) would grow in quantity and quality in the future years. The bulk of these streets have strong traffic flow, car and pedestrian movements, commercial alleys, important transport lines, regular parking turnover, and are noisy throughout the working day. The following notices and facts were recorded during site visits and personal observations:

1. The city neighborhoods surrounding the UOM location are becoming more attractive locations to live, posing considerable traffic design difficulties. These neighborhoods have become a collection of residential and commercial centers because of rapid and unregulated expansion, resulting in an intolerable amount of fluctuation in transportation demand and supply, producing numerous traffic problems.

2. In general, public transportation on these streets consists of a combination of private taxi and minibus services that operate without defined routes or timetables. They can easily imitate actual demand thanks to their high adaptability. The minibuses compete with taxis for customers to be loaded and unloaded near the college gates. As a result, regulating and controlling these modes is challenging, resulting in wasteful utilization of street lanes and traffic congestion near the gates.

3. Because of security enforcements at the university gates, traffic flow and circulation for vehicles and pedestrians are congested and unsafe, resulting in long lines on the streets near these gates. As motorists and passengers, the college community is often dissatisfied.

4. Pedestrians have to walk or wait near the campus gates during entering and exiting due to uncontrolled traffic congestion, poor transit quality or quantity, and a lack of adequate local traffic enforcement and management.

5. The share of private cars on campus has increased at a considerably fast rate during the last ten years.

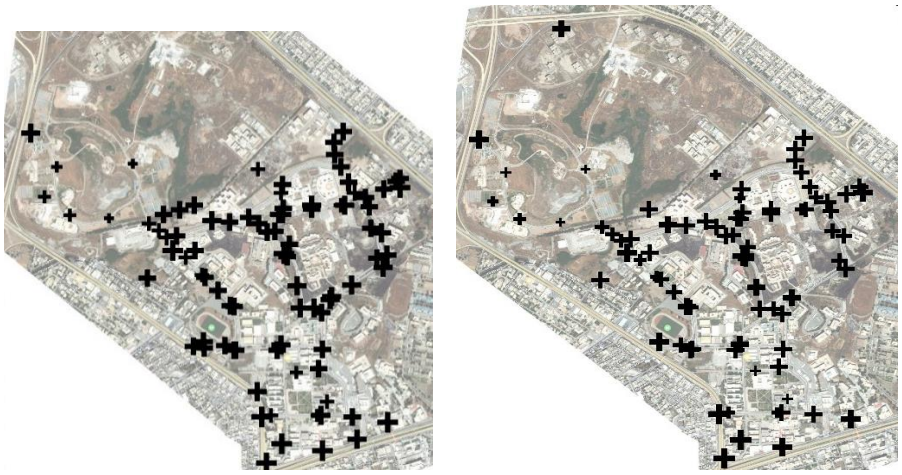
RESULTS, ANALYSIS AND DISCUSSIONS

Statistical properties of gathered noise and traffic measurements are shown on table 1.

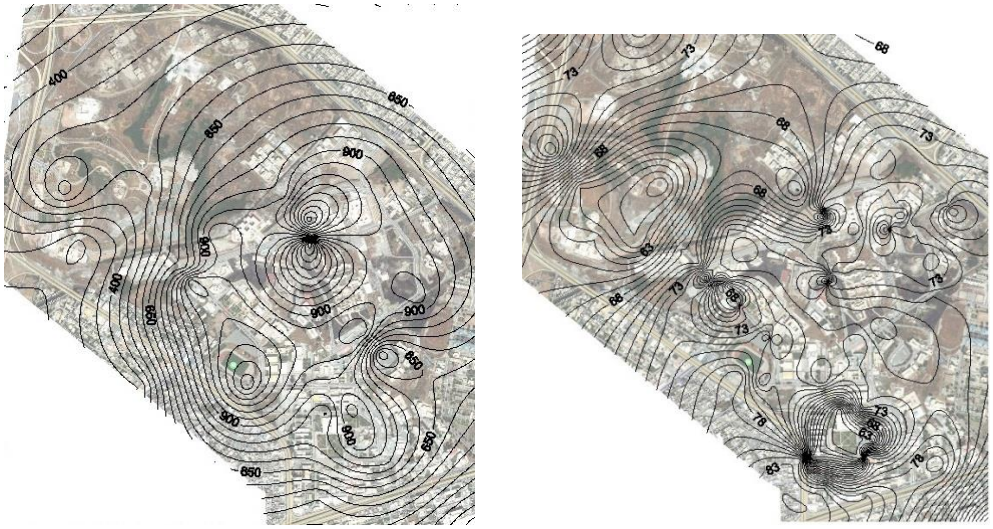
Table 1. Selected statistical properties of measured data

Property measured	counts	Min	Max	Average	St.dev
VPH	39	200	1330	743	302.3
Noise at 1m (dB)	98	60	87	78	5.9
Noise at 5m (dB)	91	60	86	75	5.7
Noise at 10m (dB)	87	58	84	72	6.1

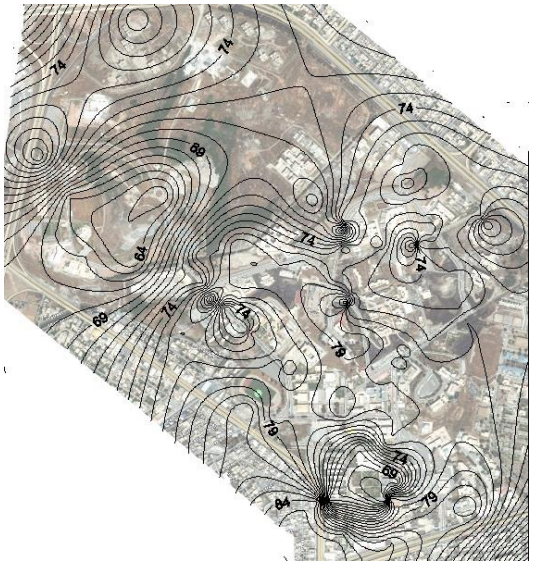
According to the table, noise levels exceed the 55 dB values



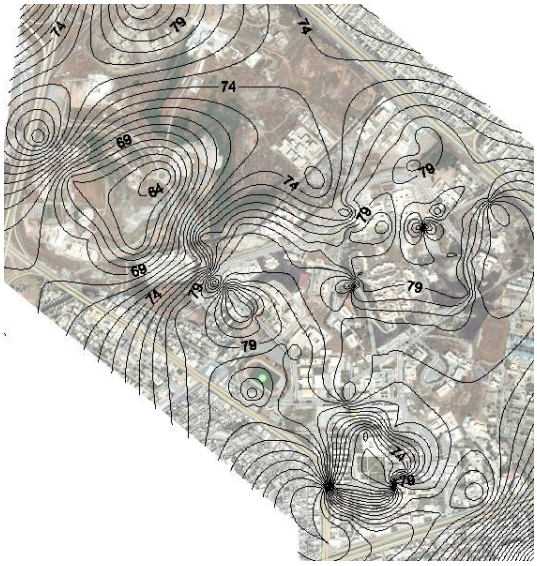
Figure(3). Locations and relative values of noise at: (a). 1m. (b). 10 m



a- Vehicle per hour



b- noise at 10 m.



. c- noise at 5 m.

. d- noise at 1 m.

Figure(4:a,b,c,d). Contour depictions for: Vehicle counts, noise levels in dB.

Careful study of the discussed data reveals that noise level varies generally from 58 dB to 98 dB, minimum noise found inside few faculty buildings and maximum noise occurs at main gates of university and near human activity regions.

CONCLUSIONS AND RECOMMENDATIONS

On the UOM campus, the number of cars and noise they produce is a major problem, especially if many of them are large and poorly maintained trucks. Changes in noise levels over a wide area can be depicted in detail using contour maps. Noise studies are frequently one of the components of the environmental impact statement for each big project. College enrollment is at an all-time high, therefore educational institutions must work hard to keep up with this growth by developing new housing and academic buildings while maintaining the effectiveness of existing ones to improve the quality of life for students and community while promoting environmental health.

The objectives of noise mapping on the main campus of Mosul University include, among other things, identifying and quantifying the extent of the noise issue on campus by providing data on noise levels to university authority and community, assisting in setting realistic noise reduction targets; and providing a tool that enables more effective use of planning controls. Traffic noise has been identified as the main source of noise for present mapping purposes. An additional source of noise comes from the nearby leisure, commercial and service activities facing the western entrances of the university. Measuring noise should be performed in a systematic method over a specified range of time to get representative values.

In order to reduce noise levels, corrective actions include, but are not limited to, better building and parking space design. Educational classrooms should be constructed away from surrounding streets and the use of acoustic wall linings. Additionally, we suggest restricting heavy trucks and vehicles pass by during class times and reduce the usage of private transport. Moreover, we suggest planting trees next to educational buildings.

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