Study of traffic flow and associated noise pollution near GLA University, Mathura (India)

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Abstract. Urbanization is increasing at a very fast rate in our country; road length and its conditions are also improving. Therefore, the number of vehicles also increasing this has led to traffic congestion on roads and noise pollution. The transportation sector is one of the major contributors to noise in an urban area. The main objective for this research was to characterize the traffic noise on the GLA University, Mathura, India. The research work of this paper is divided in two sections: (i) Traffic Study on NH-19 (ii) Traffic noise measurement at peak hours. The study includes the campus area at GLA University. The study is conducted using Sound Level Meter SLM 100 type 2. The results were compared with WHO guidelines, which states that noise level should not exceed 55 dB. Moreover, because of continuous traffic noise on NH-19 is causing increase in health issues. The impact can be harmful GLA University staff, students and people living in campus area. Hence, it can cause disease such as concentration difficulty, irritation, annoyance and are most prominent disorders due to continuous traffic noise.

Keywords: Traffic study; traffic noise; sound level; passenger car unit; traffic volume; health disorders.

1. Introduction
The growth of human society depends on the urbanization of the country's towns and cities. The urban population in India is growing rapidly compared to the global population. This rise is prevalent in the developed world and highly concentrated in mega towns.[1] In comparison to the comparatively limited percentage of available urban space, high population growth has been seen especially in developed countries. Every fourth person preferred to live in the rural area till 20th century, but by coming 21st century, every fifth person wants to live in the urban areas.[2], [3] The major reason behind it is the lifestyle of the young generation and developing infrastructures as like the corporate hubs which leads to our economic growth somewhere it impacts on our per-capita income and enhancing our disposable income where people stimulates to good purchasing power but unfortunately indirectly it increases the pollution inversely.[4]

Roads are the dominant mode of transportation in India. India is the second biggest road network in the world with 5.89 million kilometers of motorways next to the USA of over 7.0 million kilometers of highways. During the past six decades, the total length of India's road network has substantially expanded. In 1950, India had just roughly 4 Lakh kilometers of highways, although has risen to 58
2020. [5] The Indian roads hold around 90% of the overall passenger transport and 65% of the country's products. The overall growth in the number of motorized vehicles has risen tremendously in India. The annual average number of vehicles registered in India is in millions. These developments are contributing to the growth of infrastructure and, sadly, the primary outcome is traffic noise pollution.[6], [7]

Road traffic is an important factor to the noise pollution in general. The road noise causes problems in the local areas, particularly when traffic levels and high speeds are high.[8]–[10] A variety of modes such as heavy and medium lorries/buses, cars and two-wheelers are adding to the issue of noise from road traffic.[11], [12] Noise emission is the least considered but overlooked source of pollution, even in advanced countries, with the crucial implications of transport growth above.[13], [14] While this issue is increasingly rising, in the developed world the true facts have not been accepted properly. Most of the engineers, planners and policymakers in most countries are not addressing this problem. Many big cities worldwide face the issue of rising noise emissions due to the overuse of vehicles.

With the above discussion there are certain highlights which leads to heavy traffic noise pollution, further in relation to diagnose the different tools and techniques.

2. Methodology
The study area for research work was GLA University in India. It is one of the top ranked institute center in Mathura, Uttar Pradesh. Every year around 13k plus students apply for this university. Increasing demand of this university leads to traffic noise pollution. Due to their personnel vehicles, college buses. Furthermore, this university situated on National Highway -19. As Mathura city bridges Agra to Delhi. it is the prime location due to its own history. University is located at west side of Mathura. The total area of university is 445,154.16 m2 including more than 50 buildings. The very rapid traffic population of the NH-19 causes disturbances in studies and concentrations. This can also lead to disorder such as annoyance behavior, sleep disturbance and hearing loss. The map of study is being shown in fig. 1

![Mathura Map](image)

**Figure 1** Map of the study area

2.1. Traffic Study
In this research traffic volume was estimated with the help of DSLR Camera video recording on peak hour basis from morning (8:00 to 10:00 AM) and in the evening (6:00 to 8:00 PM). The traffic volume was calculated by measuring the number of vehicles on either side of the lane. The block diagram of parameters on traffic evaluation is represent in fig.2.
2.1.1. Traffic Parameters. The noise level is directly proportional to traffic volume. The average number of vehicles per hour on road in known as traffic volume. The number of heavy and light motor vehicles is an important factor for creating annoyance.

2.1.2. Noise Evaluation. A sound level meter is a basic prerequisite for noise analysis. It is programmed to evaluate the loudness sensitivity level of human ear and provides the noise intensity level with required repeatable observations. To compute the equivalent level, maximum level and minimum level of noise. In this study sound level meter 100 (Type-II) is used. In which frequency weighing “A” type and time weighing SLOW and FAST mode provided as per requirements of (IS 15575(Part-1) 2005). The block diagram of working sound level meter represent in fig.3.
3. Result and Analysis

3.1 Traffic Study Analysis. Variation of traffic volume during observation period have been shown in fig.6.1 and 6.2 and statistics has been represented in table 1. In the categorized vehicular traffic sample, a total number of 3 classes are selected i.e., Light Motor vehicles, Heavy motor vehicles and Non-Motor vehicles. Traffic data obtained during data collection were converted to passenger car units for quantitative analysis. The Passenger car unit conversion values adopted from IRC: 106-1990.

Table 1: Analysis Of PCU During Peak Hours

| Time         | Light Motor vehicles | Heavy Motor vehicles | Non-Motor vehicles | Total vehicle | Total Passenger car unit |
|--------------|----------------------|----------------------|-------------------|---------------|-------------------------|
| 8:00-9:00 AM| 1609                 | 836                  | 104               | 2549          | 4858.2                  |
| 9:00-10:00 AM| 1556                | 715                  | 265               | 2536          | 4599                    |
| 6:00-7:00 PM| 1765                | 1109                 | 158               | 3032          | 6105.3                  |
| 7:00-8:00 PM| 1431                | 1331                 | 89                | 2851          | 6489.2                  |
| Total        | 6364                | 3991                 | 616               | 10,968        | 22,051.7                |

Figure 5 Sound Level Meter

Figure 6.1: Peak Traffic Variation
The outcome of survey and analysis showed that the NH-19 carry traffic volume from 10 thousand to 968 thousand vehicles on peak hours per day.

3.1.1. Traffic Noise Level Analysis. Variation of traffic noise level during peak hour observation period have been shown in fig.7.1 and 7.2. Furthermore, statistics have been represented in table 2 and table 3.

3.1.1.1 Day Time Peak Hour Analysis. After observation of sound level meter reading from 8-10 AM in the range 2 i.e., 50-100 dB. It was observed that the collected data range of traffic noise is 73.20 -84.50 dB. As, per WHO guideline the maximum sound level should not exceed 55dB. Leq (Level of equivalent) should be used to measure continuing sounds such as road traffic noise. The average of Leq is 77.46. Due to the increase in mean traffic noise pollution is causing harm on human health resulting lack in concentration in working hours, annoyance in student and employee behavior and many more. The standard deviation of Leq is 1.89. Skewness is a measure of the asymmetry of the probability distribution of a real-valued random variable about its mean. The skewness value can be positive, zero, negative, or undefined. Kurtosis describes the shape of a probability distribution and there are different ways of quantifying it for a theoretical distribution and corresponding ways of estimating it from a sample from a population. Furthermore, Kurtosis and skewness both are also evaluated. Kurtosis and skewness for Leq is 2.26 and 0.47.
Table 2: Statistics Analysis Morning Peak Hour

| Descriptive Statistic (Morning) |       |
|--------------------------------|-------|
| Minimum                        | 72.30 |
| Maximum                        | 84.50 |
| Mean                           | 77.46 |
| Standard Error                 | 0.17  |
| Median                         | 77.30 |
| Mode                           | 76.90 |
| Standard Deviation             | 1.89  |
| Sample Variance                | 3.58  |
| Kurtosis                       | 2.26  |
| Skewness                       | 0.47  |

3.1.1.2 Night time peak hour analysis. After observation of sound level meter reading from 6-8 PM in the range 2 i.e., 50-100 dB. It was observed that the collected data range of traffic noise is 73.20 - 84.50 dB. The average of Leq is 85.96. Due to the increase in mean traffic noise pollution is causing harm at alarming rate on human health resulting in sleeping disorders, annoyance in human behaviour. And can result in long term chronic disorders. The standard deviation of Leq is 4.18. Furthermore, Kurtosis and skewness both are also evaluated during night time peak hours. Kurtosis and skewness for Leq is -0.65 and 0.00. 
4. Conclusion
According to traffic study and noise study, it revealed that the traffic noise is increasing at an alarming rate. It should be taken seriously and is observed that people working and residents in GLA University located near NH-19 are ignoring traffic noise and its effects on them. Furthermore, it will cause long term disease and at times non curable such as deafness. Hence, protective measures must be taken. Also, GLA University may be exposed to noise levels that put them at risk of being highly annoyed or having high levels of lack in concentration, sleep disturbance, irritation in behaviour etc. Increase the awareness regarding noise-induced hearing loss and regular check-up implementation is highly recommended. These results, if generalized to other urban areas with high levels of road traffic, indicate that it may be important for the public’s health to update existing noise-related policies or develop new ones to control and abate noise concerns in urban communities.
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