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# MEASUREMENT AND ANALYSIS OF NOISE LEVEL ALONG A HIGHWAY CORRIDOR

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**ABSTRACT**

Traffic noise from highways creates problems in the surrounding areas specially when traffic volume is very high and vehicles run at high speeds. Vehicular noise problem is generated by various kind of vehicles like heavy vehicles, medium buses and trucks, automobiles and two wheelers .In this paper an attempt has been made to assess the noise level along a highway corridor (SH- 1, Gorakhpur-Deoria Road, U.P.). Noise level Measurement was carried out at seven locations considering different land use pattern. FHWA model has been used for prediction of noise levels. Results obtained from observed and predicted values of noise level were compared with the standards prescribed by CPCB. It has been found that noise level at all seven locations were higher than the prescribed limit of Central Pollution Control Board (CPCB).

***Keywords: Equivalent noise level, noise indices, FHWA Model, CPCB.***

## I. INTRODUCTION

Noise ia a unwanted sound energy and is considered as a pollutant when it exceeds certain limits. Noise has short residence and decay time and hence does not remain in the environment for a long periods. Noise annoys, distracts, disturbs and with sufficient exposure causes physiological effects leading to deafness. Annoyance results from interference concentrated work, rest or sleep or with individual communication or speech. Noise in the work place reduces productivity, efficiency, accuracy and safety. Noise pollution is by now recognized worldwise as a major problem for the quality of life in urban area . In most of the developed countries, standards for noise exposures are important part of environmental policy to improve local environmental quality.

Numerous noise surveys conclusively reveal that busy road traffic is the predominant source of annoyance. There is no other single noise has been of comparable importance (Goswami, 2011; Banerjee and Chakraborty 2006). In India, some studies on traffic noise assessment have been carried out at different cities like Aurangabad (Bhosale et al., 2010), Delhi (Nirjar et al., 2003, Kumar et al., 2004), Mumbai (Naik, 1998), Varanasi (Pathak et.al., 2008), Kolkata (Chakraborty et al., 2002), Chennai (Kalai Selvi and Ramchandraiah, 2009) etc. and found that average noise levels in these cities have been higher than the prescribed limit. Heavy traffic volume,higher speeds and more number of trucks and buses in general and motor bikes in particular create enormous noise.Hence an attempt has been made to study the road traffic noise along the ( SH-1, Gorakhpur-Deoria Road) at seven locations around Gorakhpur city, ( U.P).

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## II. MATERIALS AND METHODS

### 2.1 Selection of Sampling Locations

On State Highway SH-01, (Gorakhpur- Deoria Road), total number of 7 sampling stations have been selected for the observation of traffic volume, speed and noise level. A map showing location of monitoring stations in the vicinity of Gorakhpur is shown in Fig. 1.Location of the monitoring stations were selected according to CPCB guidelines.Details of the monitoring stations are given in table1

**Table 1: Location of Noise Monitoring Stations**

| Sampling Station No | Name of the Noise Monitoring Station |
|---|---|
| 1 | Kunraghat |
| 2 | Engineering College |
| 3 | RaniDiha |
| 4 | Deoria Bi-Pass |
| 5 | Motiram Adda |
| 6 | Chauri Chaura |
| 7 | Gauri Bazar |

### 2.2 Equipment Used

The basic noise data were obtained using sound level meter (Bruel and Kajer 2232) placed 1.2 meter above the ground (Figure 2). Vehicles have been divided into seven categories like motorcycle scooter, autorickshaw, car/jeep/van, low commercial vehicle/minibus, bus, truck and tractor/trailer. A field data collection program was chalked out to collect data regarding the following parameters: classified traffic volume, classified traffic speed and ambient noise level.

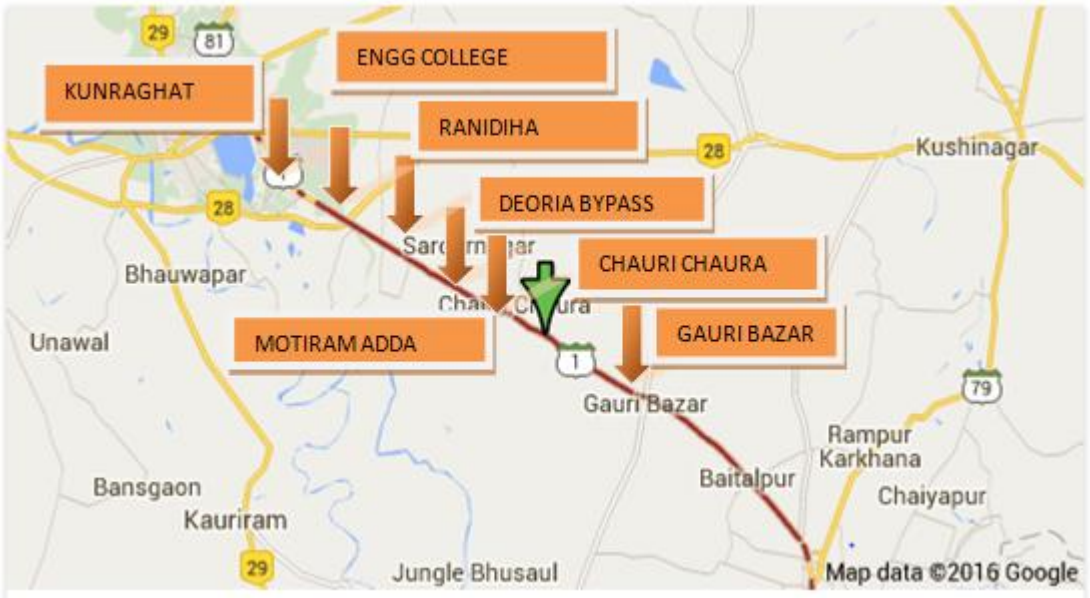


**Fig. 1: Location map of monitoring stations**

### 2.3 Measurement of ambient noise level.

Noise monitoring were carried out at all the locations during Peak hours (7.00 A.M to 11 A.M. in the morning and 5.00 P.M to 9.00P.M.in the evening). Sampling has been done at mid hour from 25 minute to 35 minute for 10 minutes duration. The noise level values are recorded at 15 second interval and hence for 10 minute duration, 40 data are recorded. The recording is done with the help of precision sound level meter of make 'Bruel and kjaer' Denmark (2232) and in dB (A) weighting network. During the sampling process the distance from the centerline of the road was 10 meters and the height of sound level meter was 1.2 meter from the ground level.

### 2.4Traffic volume

Traffic volume is calculated manually at selected observation stations. Total number of vehicles passes in each type passing in one hour in a single direction is recorded in terms of vehicles/hour.


**Fig: 2: Sound level meter Bruel and Kjaer (2232)**

### 2.5 Spot speed measurement

For speed measurement, two points were marked with a known distance (75 metre) on the road near the sampling station.With the help of stop watch, the time taken by the vehicle to cross that distance is recorded. Dividing the distance with the time taken in crossing the distance, the speed in kmph for each type of vehicle is calculated and recorded for each hour of study.

## III. NOISE DESCRIPTORS

Noise descriptors such as L10, L50, L90, Leq, and LNP were recorded. $L_{10}$ is the noise level that is exceeded 10% of the time, and represents peak noise level. This parameter is a useful indicator for situations where short

duration and high impulsive noise levels are expected. $L_{50}$ is the noise level which is exceeded 50% of the time and is close to average noise level. $L_{90}$ is the noise level which is exceeded 90% of the time and represents background noise level. Leq or the equivalent sound level is an energy average of sound level during a specified period of time. From the noise exposure view point, Leq correlates well with the effects of noise on people and this indicator is used for the use of noise impact analysis. CPCB has established noise standards for protecting population likely to be exposed to different noise sources. These noise standards are provided as Leq for daytime and nighttime and are given in the table 2.4

**Table 2: Ambient Noise Standards Prescribed by CPCB For Different Land Uses**

| Sr. No. | Category/Land Uses of Area | Limits in dB(A) $L_{eq}$ | |
|---|---|---|---|
| | | Day Time | Night Time |
| 1 | Industrial Area | 75 | 70 |
| 2 | Commercial Area | 65 | 55 |
| 3 | Residential Area | 55 | 45 |
| 4 | Sensitive Area | 50 | 40 |

## IV. FHWA MODEL

In the present study Federal Highway Administration Model (FHWA model) has been used for prediction of noise level. Vehicles were classified into seven categories. The hourly Leq value foe each category of vrhicle is calculated using the following formulae

$$\mathbf{L_{eqi} = L_O + A_{vs} + A_D + A_S}$$

$L_{eqi}$ = Hourly equivalent noise level for each vehicle type

$L_O$ = The reference energy mean emission level

$A_D$ = Distance correction

$A_{vs}$= Volume and speed correction

$A_S$ = Ground cover correction

### 4.1 Calculation of equivalent noise level

Noise level for each vehicle type ($L_{eqi}$) is calculated and then calculates logarithmically to get the total hourly $L_{eq}$value and the combined hourly $L_{eq}$value is calculated by logarithmic summation of hourly $L_{eq}$value of each category.

$$L_{eq} = 10log \sum_{i=1}^{i=n} 10^{L_i/10} \times t_i$$

Where n = total number of sound samples

$L_i$ = noise level of any $i^{th}$sample

$t_i$= time duration of $i^{th}$sample expressed as fraction of total sample time

### 4.2 Traffic Noise Index

The base measure for the traffic noise index (TNI) is the A weighted sound level sampled at numerous discrete intervals outdoors over a 24 hour period and it is the weighted combination of L10 and L90 and is given by

$TNI = 4(L_{10}-L_{90}) + L_{90} - 30$

## V. RESULT AND DISCUSSION

Noise level monitoring was carried out at seven locations during peak hours .Equivalent noise level and other noise descriptors were calculated. Knowing classified traffic volume, average speed and other ground conditions, FHWA model have been used for prediction of noise level at all the locations and the results are shown in table 3 to table 9.

**Table 3: Comparison of noise levels at SH-1 Kunraghat**

| Time(hour) | Observed hourly Leq | Predicted hourly Leq |
|---|---|---|
| 07-08 | 81.12 | 75.32 |
| 08-09 | 83.58 | 77.22 |
| 09-10 | 84.14 | 71.36 |
| 10-11 | 78.25 | 68.26 |
| 16-17 | 76.47 | 69.74 |
| 17-18 | 85.35 | 77.32 |
| 18-19 | 89.41 | 86.48 |
| 19-20 | 93.54 | 91.21 |

**Table 4: Comparison of noise levels at SH-1, Engineering College**

| Time(hour) | Observed hourly Leq | Predicted hourly Leq |
|---|---|---|
| 07-08 | 83.23 | 76.52 |
| 08-09 | 82.86 | 75.82 |
| 09-10 | 84.51 | 71.68 |
| 10-11 | 81.96 | 75.31 |
| 16-17 | 85.64 | 76.14 |
| 17-18 | 87.93 | 74.85 |
| 18-19 | 87.98 | 83.25 |
| 19-20 | 86.84 | 86.67 |

**Table 5: Comparison of noise levels at SH-1, Rani Diha**

| Time(hour) | Observed hourly Leq | Predicted hourly Leq |
|---|---|---|
| 07-08 | 86.12 | 78.12 |
| 08-09 | 84.67 | 77.69 |
| 09-10 | 81.35 | 78.27 |
| 10-11 | 79.84 | 76.64 |
| 16-17 | 74.86 | 77.68 |
| 17-18 | 86.31 | 79.81 |
| 18-19 | 88.23 | 80.63 |
| 19-20 | 90.41 | 80.84 |

**Table 6: Comparison of noise levels at SH-1 Deoria Bi-Pass**

| Time(hour) | Observed hourly Leq | Predicted hourly Leq |
|---|---|---|
| 07-08 | 88.51 | 79.51 |
| 08-09 | 89.35 | 80.25 |
| 09-10 | 85.23 | 80.87 |
| 10-11 | 86.14 | 82.36 |
| 16-17 | 89.74 | 84.58 |
| 17-18 | 90.51 | 86.75 |
| 18-19 | 91.04 | 87.21 |
| 19-20 | 92.25 | .21 |

**Table 7: Comparison of noise levels at SH-1 Motiram Adda**

| Time(hour) | Observed hourly Leq | Predicted hourly Leq |
|---|---|---|
| 07-08 | 87.46 | 78.15 |
| 08-09 | 88.51 | 79.26 |
| 09-10 | 89.28 | 80.59 |
| 10-11 | 90.23 | 81.21 |
| 16-17 | 91.17 | 82.26 |
| 17-18 | 92.89 | 84.76 |
| 18-19 | 93.14 | 86.50 |
| 19-20 | 94.06 | 88.62 |

**Table 8: Comparison of noise levels at SH-1, Chauri Chaura**

| Time(hour) | Observed hourly Leq | Predicted hourly Leq |
|---|---|---|
| 07-08 | 90.12 | 82.54 |
| 08-09 | 92.21 | 83.06 |
| 09-10 | 93.06 | 84.79 |
| 10-11 | 94.72 | 86.15 |
| 16-17 | 95.64 | 87.04 |
| 17-18 | 96.58 | 88.62 |
| 18-19 | 97.19 | 89.28 |
| 19-20 | 97.59 | 90.24 |

**Table 9: Comparison of noise levels at SH-1, Gauri Bazar**

| Time(hour) | Observed hourly Leq | Predicted hourly Leq |
|---|---|---|
| 07-08 | 89.52 | 81.52 |
| 08-09 | 90.26 | 82.17 |
| 09-10 | 91.63 | 83.73 |
| 10-11 | 92.41 | 85.26 |
| 16-17 | 93.47 | 86.72 |
| 17-18 | 94.75 | 88.35 |
| 18-19 | 95.48 | 89.46 |
| 19-20 | 97.36 | 91.06 |

## VI. CONCLUSION

Present study was carried out to assess the noise level at different locations along a highway corridor (SH-1) near the Gorakhpur city. On the basis of observed and predicted results, following conclusions were made:

1. The observed and predicted values of noise levels at all the monitoring stations were higher than the prescribed limit given by the Central Pollution Control Board (CPCB).
2. It is observed that FHWA model can be applied successfully for prediction of noise level along highway corridor by making some suitable adjustments.
3. A questionnaire based survey was carried out to get responses from peoples residing in the nearby areas.The primary data was collected and analyzed .It was found that road traffic noise is a major concern to the people residing in the vicinity of the studied locations. Thus there is need to take some preventive measures to minimize the noise level.
4. With a view to control the traffic noise, plantation of trees,the restrictions on the traffic flow and speed can be planned specially along the highway corridors located in the vicinity of cities and urban areas.

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