Evaluation of Urban Traffic Noise Pollution - A Case Study of Rajkot City

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***Abstract*—Noise pollution, in the recent times, has been well recognized as one of the major trepidations that impact the quality of life in urban areas across the globe. The needs of effective remedial measures are inevitable for creating a healthy and sustainable environment. Rajkot has evidenced a very rapid growth in urbanization which resulted in increased demand for transportation and at last it resulted in increased rate of noise pollution. The main objective of research is to evaluate the noise pollution in the Rajkot city and its effect on the surroundings. In this research one urban stretch is taken as study area. Noise level are measured on the selected urban stretch and compared with standard noise levels. Noise prediction model is developed for the selected stretch of Rajkot city.**

***IndexTerms*—Noise level, L_{eq} dB, Traffic Noise, atmospheric Temperature, Wind velocity, Traffic volume.**

I. INTRODUCTION

Noise is defined as any unwanted sound. Noise can also be defined as the level of sound that exceed the acceptable level and creates an annoyance. Nowadays noise is a consequential environmental problem in urban area. Noise pollution has many negative impacts on human health. Effect of high intensity noise on human beings is as below.

Table 1Effect of high intensity noise on human being

Noise in Db	Effect of Noise observed
0	Threshold of audibility
150	Significant change in pulse rate
110	Stimulation of reception in skin
120	Pain threshold
130-135	Nausea , vomiting dizziness, interference with touch and muscle sense
140	Pain in ear, prolonged exposure cause insanity
160	Minor permanent damage if prolonged
190	Major permanent damage in short time

Noise is either man made or natural. Traffic noise is a major source of manmade noise. The main source of manmade noise in developed urban area are mechanized automobile such as trucks, buses, motors, scooters, fire engines, police cars, ambulance etc. The sound intensity is measured in decibel (dB). The level of noise is usually expressed in terms of sound pressure level (spl) in dB, sound level meters are used for measuring sound pressure level. Transportation noise is the main source of the environmental noise pollution including road traffic, railway traffic, air traffic, sea traffic.

Table 2The noise level for residential area as given in IS-4954:1968

Sr. No.	Location	Acceptable outdoor noise level in residential area dB(A)
1	Rural	25-30
2	Suburban	30-40
3	Residential	35-45
4	Urban (residential & business)	40-50
5	City	45-50
6	Industrial area	50-60

In this study the parameters which affect the noise level is studied .the various factors are traffic factors, road factors, vehicle factors and human factors which affect the noiseThe different highway noise descriptors are percentile exceeded sound level (L_x),

equivalent continuous sound level (L_{eq}), day night average sound level (L_{dn}), and Traffic noise index (TNI) and noise pollution level (NPL) .out of the above the two noise descriptors which have been mostly used in many countries to describe highway traffic noise are $L_{eq}$and L_{10}

II. LITERATURE REVIEW

Putu alit suthanaya (2015), "Modeling road traffic noise for collector road (case study of denpasar city)", The 5th international conference of euro asia civil engineering forum.125(2015)467-473

have develop the model of traffic noise particularly for collector roads in Denpasar city of Indonesia. The traffic data is collected like traffic volume (cvc), speed, and road geometric. This data were analyzed by using multiple linear regression method. This study found that motor cycle dominates the road traffic about 75%, motor cycle volume was found to be the most significant traffic noise predictor. Traffic noise model can be used to estimate the impact of traffic on the environment as a basis to design better road performances in terms of geometric and pavement surface texture. This model of traffic noise level can be used to predict vehicle noise level for collector road. The road traffic noise was measured at a distance of 1.5m from the edge of the carriageway at the height of 130 cm above the road surface. Traffic noise was measured by sound level meter model SDL600.

Paras Kumar, S.P Nigam, Narotam Kumar (2014), "Vehicular traffic noise modeling using artificial neural network approach", Transportation research part C. 40(2014)111-122

have develop the artificial neural network (ANN) model for predicting highway traffic noise in the Patiala city of India. The model input parameters are total vehicle volume per hour, percentage of heavy vehicles and average vehicle speed. The noise monitoring was done during day time at 8.00 A.M to 7.00 P.M using sound level meter. The sound level meter was mounted at a height of 1.2 m above the ground level. Beside noise monitoring, vehicle number and vehicle speed, temperature, humidity and wind condition were also measured continuously. After computing the relevant parameters, multiple linear regression analysis is carried out to predict the L_{10} and L_{eq}. The comparison was done between the experimental, regression and ANN result. The predicted output parameter from regression and ANN model have been tested against field data for testing data samples at 5% significance level using t-test. At the end of study it is concluded that high correlation and less percentage error difference between experimental and predicted output is an indication of better prediction capability of neural network as compared to regression analysis.

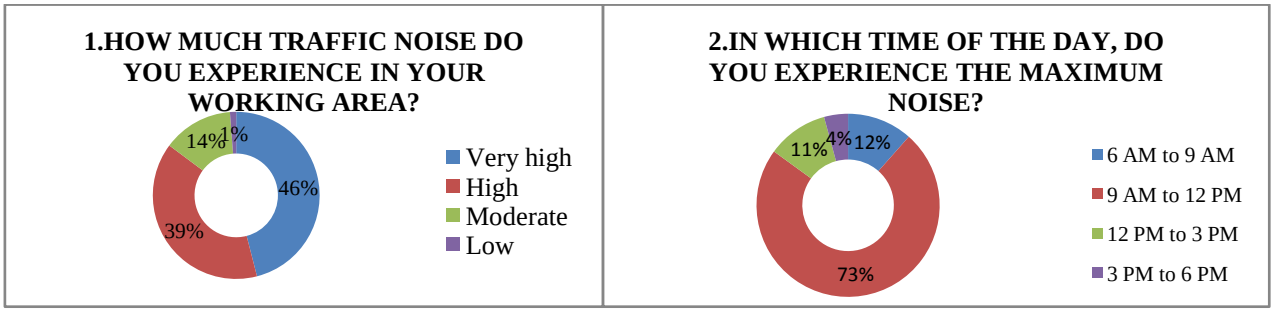
T.Subramani, M. Kavitha, K.P.Sivaraj (2012) "Modelling of traffic noise pollution", International journal of Engineering research and applications.pp.3175-3182

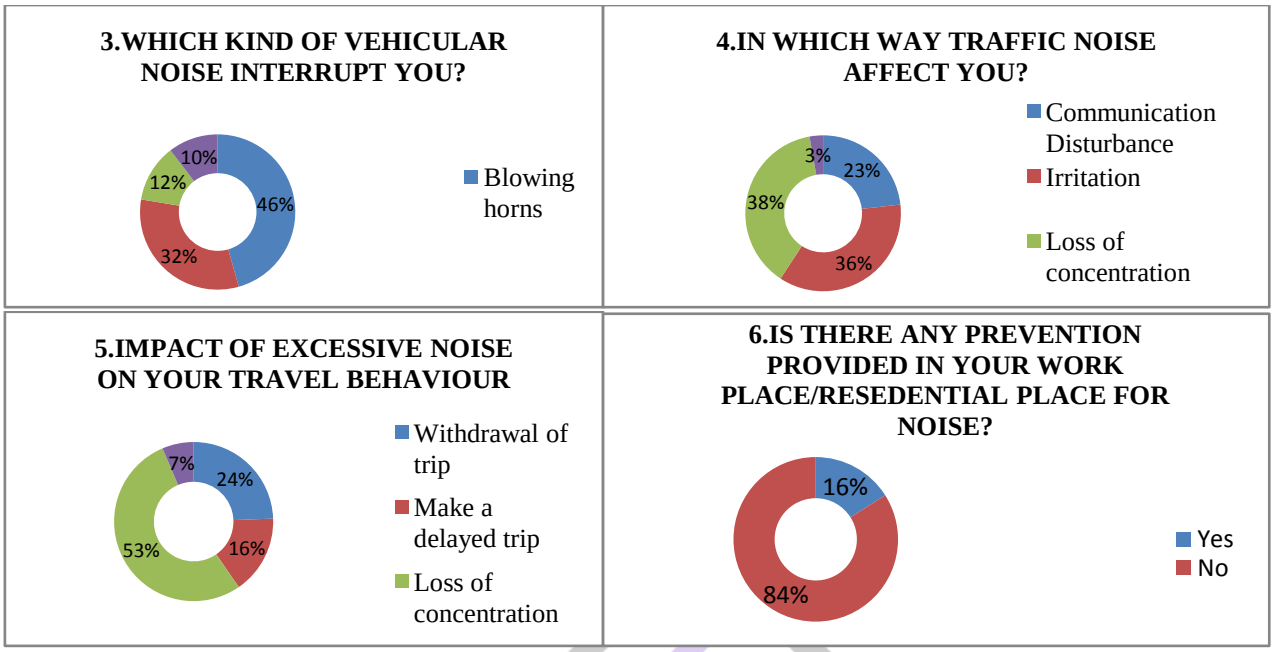
have developed the noise prediction model for the dindigul-banglore road (NH-209) at Ganesapuram, between Coimbatore and annur. The noise measurement parameters are L_{eq} and L_{10} which were recorded by sound level meter (SL 4010,lutron make).The input parameters for the model are 1.total vehicle volume per hour,2. Average vehicle speed in kmph,3. Atmospheric temperature in $^{\circ}C$, 4.and surface temperature $^{\circ}C$, 5.Relative humidity in %.the sound level meter was placed at a height of about 1.20 m above the existing road level at distance of 1.50 m from the edges of the road. Atmospheric data were recorded using a hand held digital thermo-hygrometer and surface temperature in $^{\circ}C$ was measured using a hand held laser thermometer . Vehicle count is done manually for the period of 12 hours on both side of the road. Speed of each category of vehicle is measured by using a hand held speed radar gun. Analysis of collected data is done DATAFIT software. A nominal distribution test is also applied to test the model for its goodness of fit. At the end of the study it s concluded that noise level increases with increase in total number of vehicle, in speed, and with increase in humidity. Noise level decreases with increased atmospheric pressure and with increased surface temperature**.**

III. DATA COLLECTION

An opinion survey or questioner survey is carried out to check the effect of the traffic noise on surrounding locality. Kalawad road is the main urban road of the city. Many school, colleges and hospitals are situated at kalawad road. The opinion forms are filled by people.

Below shows the result of 250 opinion form.





Noise level, wind velocity, Temperature, Traffic volume was measured simultaneously. All this data were measured at the interval of 5 minutes during morning peak hour 9 to 12 and evening peak hour 4 to 7 on both side of the road.

Table 3 noise level, wind velocity, temperature

TIME	Noise level (dB) Leq	WIND VELOCITY(Km/hr.)W	TEMPERATURE (°C)T
9:00 to 9:30	80.56	1.6	25.7
9:30 to 10:00	83.01	1.3	27.0
10:00 to 10:30	84.17	1.4	28.1
10:30 to 11:00	84.07	2.0	29.9
11:00 to 11:30	86.40	0.8	32.2
11:30 to 12:00	81.78	3.5	38.8
4:00 to 4:30	80.41	2.0	35.2
4:30 to 5:00	83.29	2.0	34.3
5:00 to 5:30	83.92	2.3	33.3
5:30 to 6:00	84.42	1.7	31.9
6:00 to 6:30	87.21	1.9	29.9
6:30 to 7:00	84.22	2.3	28.7

Table 4 Traffic volume

Time	Traffic volume				
	2W	3W	LCV	CAR	BUS
9:00 to 9:30	110	19	3	25	1
9:30 to 10:00	121	23	4	29	2
10:00 to 10:30	125	25	5	35	2
10:30 to 11:00	123	24	4	32	2
11:00 to 11:30	134	29	7	38	1
11:30 to 12:00	115	21	5	32	3
4:00 to 4:30	108	18	3	23	1
4:30 to 5:00	122	24	4	33	1
5:00 to 5:30	124	24	4	31	3
5:30 to 6:00	126	25	4	30	3
6:00 to 6:30	139	31	6	33	3
6:30 to 7:00	123	26	4	31	1

IV. DEVELOPMENT OF TRAFFIC NOISE PREDICTION MODEL

The traffic noise prediction model is developed for the selected stretch of Rajkot city. Model is developed by using the EXCEL.

Noise Level (Leq) = 64.51655 + 0.042371(W) - 0.1155(T) + 0.1709681(X1) + 0.077 (X2) + 0.025732741 (X3) + 0.002312814 (X4) - 0.043249685(X5)

Where, W= Wind velocity
T = Temperature
X1= volume of two wheeler
X2= volume of three wheeler
X3= volume of LCV
X4= volume of car
X5 = volume of buses
Value of R^2= 0.835925872

V. RESULT AND CONCLUSION

The result of opinion survey clearly shows that very high amount of people are suffering from excessive traffic noise. Around 73% of people are suffering from traffic noise between the time intervals of 9A.M to 12 P.M. The noise of blowing horns and acceleration noise causes the disturbance to the people. Many People felt the loss of concentration and irritation due to traffic noise. And around 84% of people say that there is no prevention is provided in their work place or residential place for noise. All measured noise level exceeded from the standard noise level during survey time.

The noise prediction model gives the value of R^2 which is 0.835925872. The higher value of R^2 indicates the better prediction quality of the model.as well as the higher coefficient of two wheelers indicates that the two wheelers are the major source of traffic noise. Increase in volume of two wheeler will increase the traffic noise.

At the end of the study It is concluded Rajkot city is suffering from very high amount of traffic noise and it is necessary to take some mitigation measures. For example tree plantation along the road side and use of some pavement material which reduce the interaction noise of tire with pavement surface.

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