EVALUATION OF URBAN HIGHWAY ENVIRONMENTAL NOISE POLLUTION IN HYDERABAD

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ABSTRACT: Traffic noise is a serious concern of the population living along the highway corridors. A number of models have been developed to predict traffic noise along the highway from fundamental variables (noise descriptors). Statistical methods are generally used in model envisaging and compiling. Experimental data are gathered for three sites along the National Highway No. 65 (Old NH 9) (Punjagutta, Abids and Kukatpally of Hyderabad) in the present study. Some of the most imperative noise prediction models are recapped. A methodical comparison of simulated and experimental data is made, in order to test the perfection and behavior of the models in three different studied sites in an Indian road condition.

***KEYWORDS*- Highway noise, Prediction models, Noise assessment, Noise variables.**

I. INTRODUCTION

Noise in cities is the third most hazardous type of pollution, right after air and water pollution. Noise pollution has become a major concern of communities living in the vicinity of major highway corridors. In view of the rapid development it is essential to study highway noise with respect to various causative factors. Noise levels are showing an alarming rise and in fact level exceeds the prescribed levels in most parts of India. There are many auditory and non-auditory health effects on communities living in close proximity to busy highways[1]. Thus, to reduce road traffic noise, many countries have introduced noise emission limits and legislations for vehicles[2]. On the other hand, road infrastructures and vehicles number are increasing day by day, where transport facilities are improving in order to support the economical and industrial growth of the country. The recognition of highway noise as one of the main sources of environmental pollution led to design models that enable us to predict traffic noise level. Several models have been developed from fundamental variables such as the traffic flow, speed of vehicles, volume of the traffic and sound emission level using regression analysis of experimental data.

A mathematical model is used to measure the noise due to direct propagation, diffraction and deflection for road traffic noise in urban situation. The heavy vehicles such as trucks and buses play a major role in road traffic noise in urban areas[3]. A number of models for predicting noise levels generated by urban road traffic under interrupted flow conditions were developed[4]. Another motor traffic noise model based on the perpendicular propagation analysis technique (direction perpendicular to the centerline of motorways carriageway) is found performed well in a statistical goodness of fit test against the field data. A statistical model of road traffic noise in an urban setting which is based on the fact that percentage of heavy vehicles plays an important role over road traffic noise emission was developed[5]. Subsequently, some developed models for prediction of road traffic noise were suggested[6] and are reviewed[7]. Models are generally used to predict sound pressure levels specified in terms of Leq, L10, L50, L90 etc.[7].

In this paper, the different noise models have been quantitatively described and compared in function of the number of vehicles. The comparison is here extended to experimental measurements. The behavior of the models in different sites and in different hours is sketched. The present study is an attempt of comparison of simulated and experimental data monitored in NH-65 with an objective of identifying the best predicted traffic noise model (s) in the Indian conditions.

II. REVIEW OF SOME TRAFFIC NOISE MODELS

In this section, some of the most used TNMs (Traffic Noise Models) are briefly sketched. In all the formulas,

- Leq is the equivalent noise level
- Q is the vehicles flow
- P is the percentage of heavy vehicles
- d is the distance of source to receiver

II.1 Burgess, 1977

$$Leq = 55.5 + 10.2 \log (Q) + 0.3P - 19.3 \log (d) \qquad (1)$$

This model is used first time in Sydney, Australia. This is one of the first models applied for the prediction of equivalent noise level (Leq) in Australia.

II.2 CSTB, 1991

$$Leq = 0.65\ L50 + 28.8\ [dB\ (A)] \quad (2)$$

The value of L50 is calculated taking in to account only the equivalent vehicular flows (Qeq) and is given by:

$$L50 = 11.9\ LogQ + 31.4\ [dB\ (A)] \quad (3)$$

For urban road and highway with vehicular flows lower than 1000 vehicles/hour;

$$L50 = 15.5\ Log\ Q - 10\ Log\ L + 36\ [dB\ (A)] \quad (4)$$

For urban road with elevated buildings near the carriageway edge, with L, the width (in meters) of the road near the measurement point.

III. MATERIALS AND METHOD

The present study is conducted in NH-65 (Punjagutta, Abids and Kukatpally) of Hyderabad (Fig. 1) during May-June, 2018. Hyderabad is located at 17.37° North and 78.48° East. The basic data are gathered using digital maps and field observations. The noise levels are measured following standard procedure using calibrated sound level (dB) meter (Model LUTREN, SL-4010)[12]. The days and hours of sampling are random. In this study, the A-weighted continuous equivalent sound level values (Leq), Lmax, Lmin and statistical levels of L10 (peak noise), L50 and L90 (background noise) are manually measured at each site separately. Equivalent noise levels (Leq) represents the equivalent energy sound level of a steady state and invariable sound. It includes both intensity and length of all sounds occurring during a given period. The noise levels of different sites in different time intervals are predicted along with their equivalent noise levels (Leq). The value of Leq in dB (A) unit is calculated by using the formula of Robinson, 1971, i.e.,

$$Leq = L50 + (L10 - L90)^2 / 56 \quad (5)$$

Thus, experimental data (Leq) are gathered for three investigated sites along the NH-65 in the present study. Simulated data (Leq) are derived by applying a number of already discussed Traffic Noise Models (Burgess, 1977, CSTB, 1991). A methodical comparison of simulated and experimental data is made in order to test the perfection and behavior of these models in three different studied sites in an Indian road condition.

The measurements are taken on various days of the week. All the experimental data have been collected in absence of rain, with a wind speed below 5 m/s and relative humidity below 80% (maximum value).

IV. RESULTS AND DISCUSSIONS

In this section a quantitative comparison between TNMs (Traffic Noise Models) and experimental data is performed. Of course, since the experimental setting is the same in three sites, one should expect a similar behavior of data. This is not always true because the acoustical measurement is in general strongly influenced by propagation effects and environmental influence. In Figs. 2, 3, 4 the comparison of calculated data and models prediction are plotted against days of measurement.

This has been studied, for instance in[1] where the discrepancy between measured and predicted results has been used as a "correction factor", in order to adjust levels predicted and perform a sort of "calibration" process in each site. Even if this process improved the sensibility of the model, in some cases measured and predicted results still differ by each other of 3 to 5 dB (A). There could be different weather conditions, such as wind, temperature and humidity that affect the measurement and are not accounted by predictive models. In Figs. 2, 3, 4 the comparison in three different sites is performed versus days of measurement.

In Figs. 2, 3 and 4, the comparison in three different sites is performed versus day of measurement. The minimum noise levels (Leq) measured at Punjagutta, Abids and Kukatpally are 74.54, 75.74 and 73.49 dB, respectively. Similarly, measured maximum noise levels (Leq) at Punjagutta, Abids and Kukatpally are 76.02, 77.35 and 74.38 dB, respectively. All these values clearly show high noise levels along NH-65. Being Punjagutta, Abids are commercial areas showing high noise levels that of Kukatpally is a residential area which shows less as compared.

As a whole, calculated Leq values from the monitored data are methodically compared with Leq values of three investigated sites along the NH-65 predicted by two different Traffic Noise Models in the present study. The firm comparison of these simulated and monitored data of Leq demonstrates that the two models are reliable to predict traffic noise in Indian conditions.

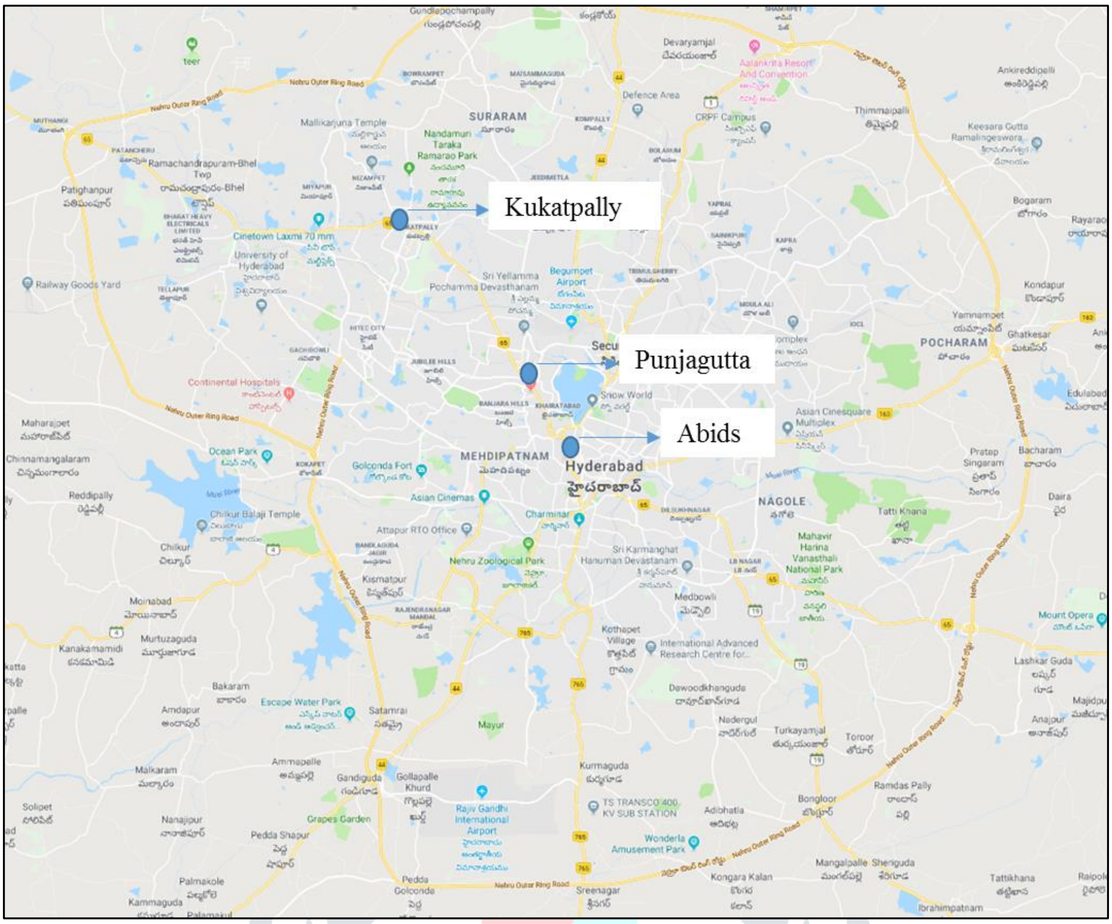

Figure 1: Study areas showing on NH-65

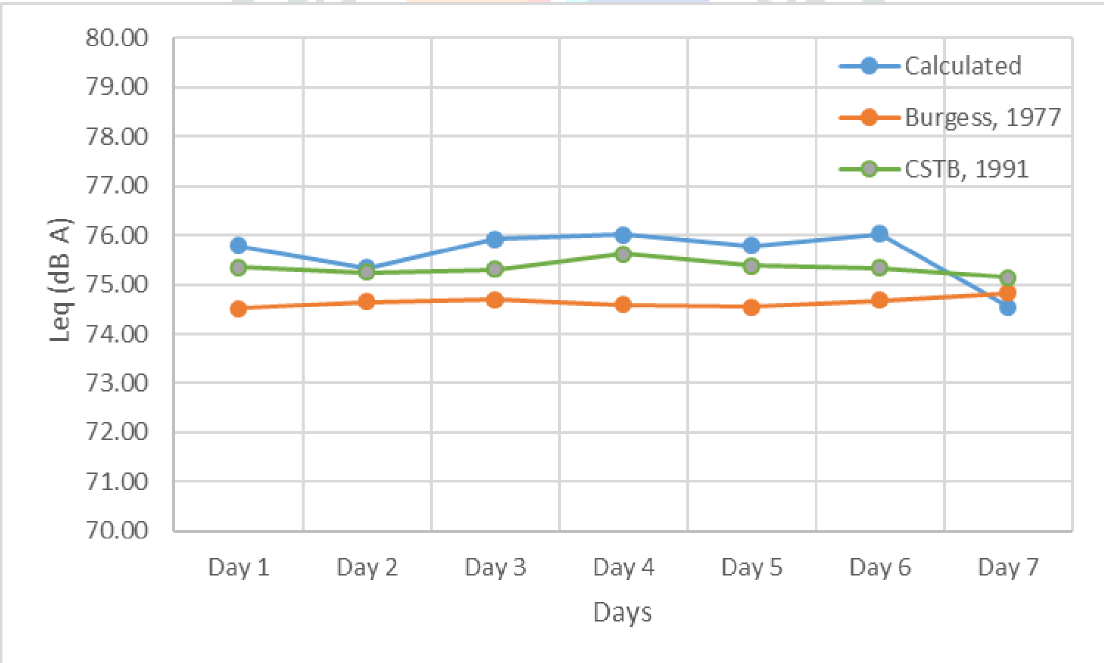

Figure 2: Calculated and predicted Leq plotted versus days of measurements at Punjagutta

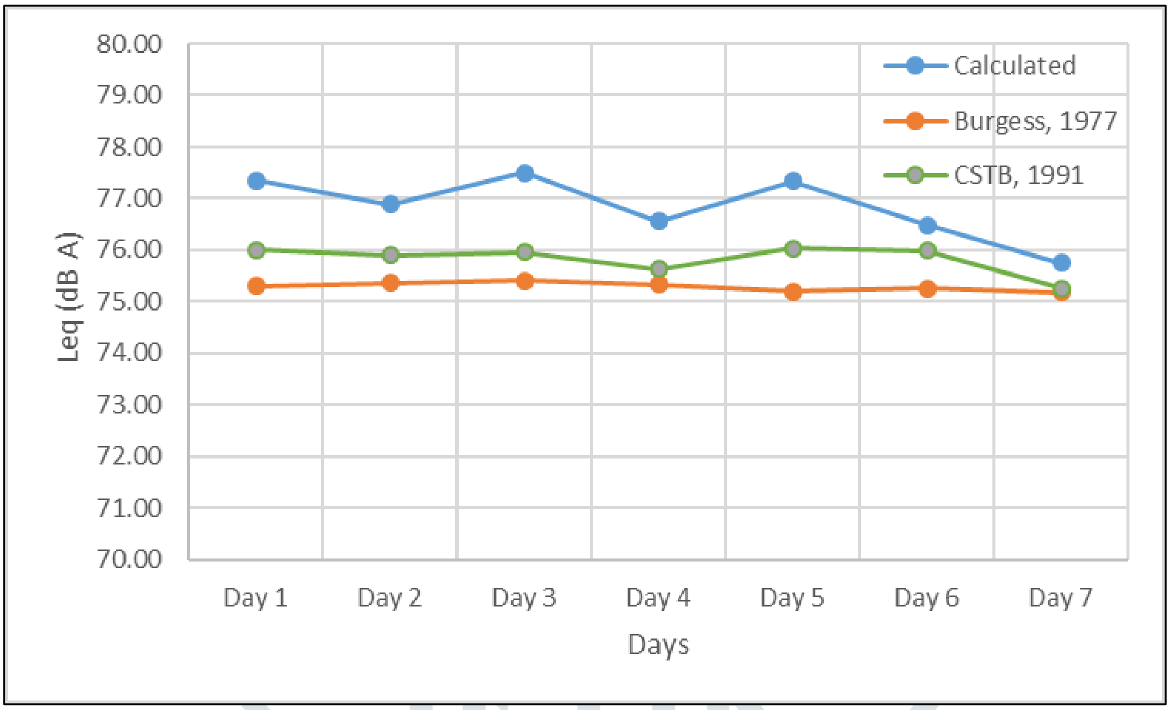

Figure 2: Calculated and predicted Leq plotted versus days of measurements at Abids

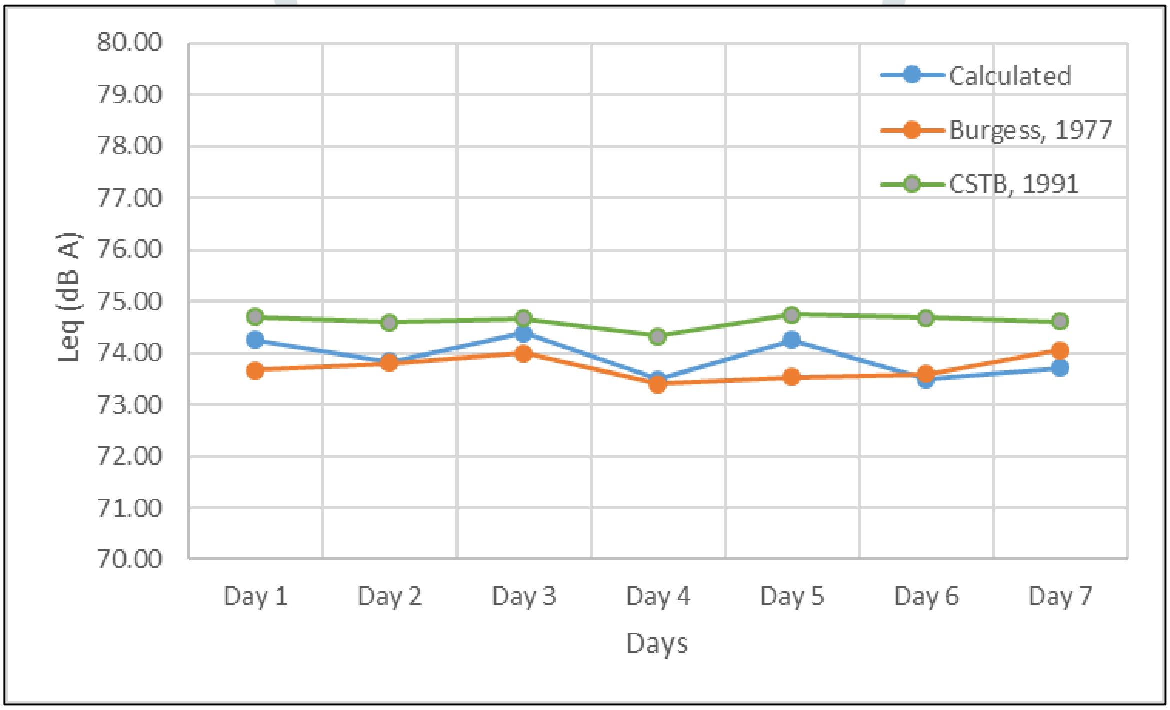

Figure 3: Calculated and predicted Leq plotted versus days of measurements at Kukatpally

V. CONCLUSIONS

The present study clearly revealed that the transportation sector is one of the major contributors to noise in these urban areas located along the NH-65. Such noise measurements and prediction could be helpful in understanding the problem of noise pollution along the urban highways. As unplanned highways are passing through heart of most of the cities, by-pass road, over-bridges / flyovers should be constructed to avoid excruciating highway traffic. Design and fabrication of silencing devices and their use in trucks, buses, cars, motorcycles, would be an effective measure in abating highway noise. Moreover, ban on honking of air horns and planning main traffic arteries, nurturing green plants along the highways are the need of the hour. Trees with dense foliage are found to be highly effective in absorbing the acoustic noise and act as very good screens in bringing down the noise levels. Programs to monitor and control noisy vehicles on the roads should be launched. Before commencing any highway project, potential sources of noise pollution associated with the proposed project should be identified by the land use planners.

VI. REFERENCES

[1] Anonymous 2004. TNM Version 2.5. Addendum to Validation of FHWA's Traffic Noise Model® (TNM): Phase 1. U. S. Department of Transportation, Federal Highway Administration, Final Report.

[2] Babisch, W. 2005. Noise and health. Environ. Health Perspect. 113 (1), 14-15.

[3] Calixto, A., Diniz, F. B. and Zannin, P. H. T. 2003. The statistical modeling of road traffic noise in an urban setting. Cities. 20 (1), 23-29.

[4] Centre Scientifique et Technique du Batiment (CSTB) 1991. Etude théorique et expérimentale de la propagation acoustique, Revue d'Acoustique 1991. 70.

[5] C.P.C.B. 2000. Schedule Ambient Air Quality in Respect of Noise. In: The Noise Pollution (Regulation and Control) Rules, 2000, Central Pollution Control Board, New Delhi.

[6] Golmohammadi, R., Abbaspour, M., Nassiri, P. and Mahjub, H. 2007. Road Traffic Noise Model. J. Res. Health Sci. 7 (1), 13-17.

[7] Goswami, S. 2009. Road traffic noise: A case study of Balasore town, Orissa, India. Int. J. Environ. Res. 3 (2), 309-316.