Research Paper Engineering

Study and Development of Road Traffic Noise Model

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ABSTRACT

The major contribution of the traffic noise, towards overall noise pollution Traffic noise from highways creates problems for surrounding areas, especially when there are high traffic volumes and high speeds. Vehicular traffic noise problem is contributed by various kinds of vehicles like heavy, medium trucks/buses, automobiles and two wheelers. Many western countries have developed different prediction models based on L10, Leq and other characteristics. This has lead to overcrowded roads and pollution. The present work discusses the fundamentals of acoustics and analysis of vehicular traffic noise. A mathematical model is developed at andhajan mandal crossing at Ahmadabad. A large number of sets of data were recorded for 15 minutes duration at different dates/timings in a random/staggered manner in order to account for statistical temporal variations in traffic flow conditions. The noise measurement parameters recorded were Leq, L10, Lmax and Lmin. Sound level meter was used for these measurements

Keywords : noise pollution, traffic noise

INTRODUCTION TO NOISE

In our modern, rapidly expanding environment one of the developing problems is that of noise. This particular problem is becoming a Source of serious concern to industrial corporations, trades. Basically, noise is sound, while under some circumstances sound is noise. Noise is conveniently and concisely defined as “Unwanted Sound”, an essentially personal definition. The object of this part is to discuss the concept of noise, problems of noise and its effect on man and environment both as annoyance and as a danger to health

The major sources of noise are:
1. Industrial noise
2. Traffic noise
3. Community noise

Out of above three parameters, the source that affects the most is traffic noise. In traffic noise, almost 70% of noise is contributing by vehicle noise. Vehicle noise, mainly, arises from two parameters i.e. engine noise and tyre noise. The major concern is to study and development of a road traffic noise model.

Physical Properties of Sound

If a device, which can detect small pressure variations (microphone) is placed in the sound field, it will produce an electric signal proportional to the sound pressure. The unit of sound pressure is Pa (Pascal=N/m2).The range of audible sound pressure variations is very wide ranging from 2x10-5 Pa=20μPa, which is threshold of hearing (Pt) to approximately 100 Pa, the threshold of pain (Pp). The ratio between the threshold of hearing and the threshold of pain is 5000 000: 1 equivalent to 134 dB. dB is logarithmic ratio which defines the sound pressure level L as follows: L = 20 x log10p/pref

Traffic Parameters

Traffic Volume, Q

The noise level near the highway depends on the number of vehicles. The noise level increases with an increase in traffic volume. Traffic volume is defined as the total number of vehicles flowing per hour. The number of vehicles passing through a fixed point on the road is to be counted. The traffic volume may be sub grouped into heavy vehicles and automobiles for duration of fifteen minutes. Several such samples are to be taken in different time slots ranging from 9.00 A.M. to 6.00 P.M.

Truck-Traffic Mix Ratio, P

Trucks and buses are contributing more noise to the environment, than compared to automobiles. The ratio of heavy trucks and buses to total traffic is called truck traffic mix ratio. This is computed in terms of percentage. An increase in this ratio will increase the noise level.

Speed of Vehicle, V

If the vehicle is traveling within the limited range of road speeds, the noise produced is related to the engine, which would vary with each vehicle type. Therefore, the term “V” is included in developing the model. Including vehicle speed as a parameter in the model has some approximation, because of the unavailability of speed measuring 20 instrument ‘radar gun’ i.e. vehicle speed as a parameter is tried to be taken in the present work manually. Vehicle speed is taken as an average speed of all vehicles categories ranges 40-50 km/hr. Further, this parameter is included as a log term.

Measurent Procedure:

For traffic noise problems it is useful to know the equivalent continuous sound level Leq and the 10 percentile exceeded sound level L10 .Such information is obtained using a sound level meter The sound level meter should be suitably calibrated. The microphone mounted on a tripod should suitably leveled with air bubble at a height of about 1.0 m from the ground. The noise measurements recorded are Leq, L10, Lmax, Lmin. Values of Lmax have measured to give the idea about maximum noise levels measured. Unusually high values of Lmax represent the cases of vehicles honking continuously or the

vehicles are without proper silencers, etc. Values of Lmin represent the minimum noise levels measured.

Fig-1.1Sound level meter on a tripod with windscreen

Measurement:
Traffic noise was measured on 132ft ring road at andhajan mandal crossing in Ahmedabad city. The vehicle count was also made during the measurement period. Vehicles are divided into according to Indian conditions The temperature, humidity and wind conditions were also monitored throughout. A large number of 15 minutes measurements at the same site were repeated on different dates and timings in a random manner in order to account for statistical temporal variations in traffic flow characteristics. Noise measurements are meters L10, Leq, Lmax and Lmin were recorded Average velocity of vehicles was also measured with manual methodThe following settings were kept on the sound level meter for the above measurements

Time weighting "Slow"

Pre-set time "15 minutes"

Frequency weighting "A"

Displayed parameters Leq,L10,Lmax and Lmin

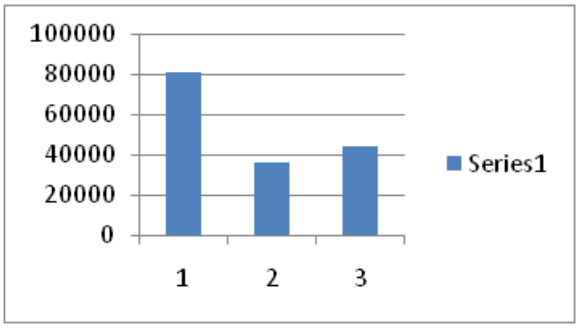


Fig-1.2,Total traffic volume

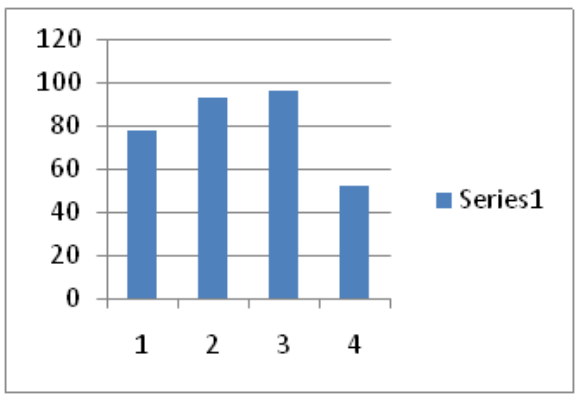
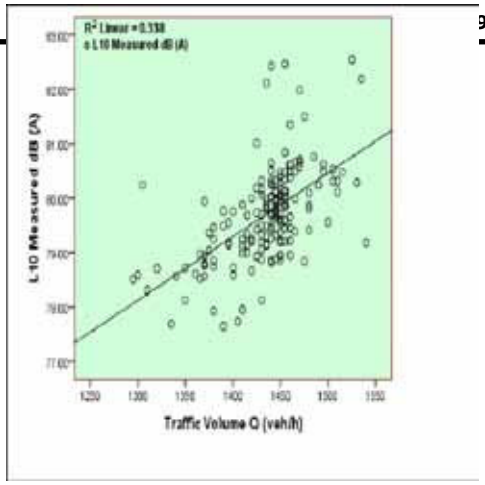
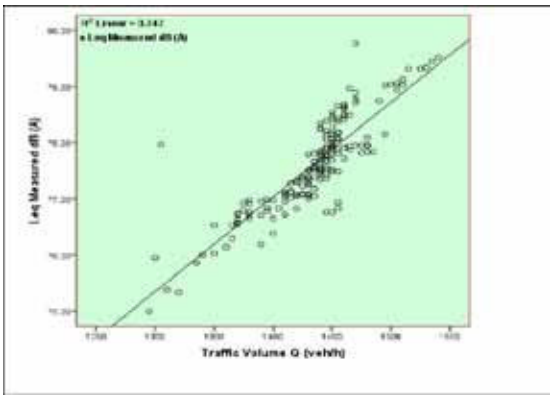


Fig-1.3, Ave value of noise level (Leq,L10,Lmax,Lmin)





Regression Output:

R square	0.7942
Standard error	0.3881
Constant	55.1781
Independent 1 (Q)	0.0113
Independent 2 (P)	0.0544
Independent 3 (V)	0.0907

Equation: Leq = 55.1781+0.0113*Q+0.0544*P+0.0907*V

Conclusion:
Collected data on noise generating parameters was applied to calculate the predicted noise level with the help of regression analysis. The comparison tests were made in order to examine the goodness of fit, between the predicted and measured noise level from the collected field data and to suggest a suitable model for Indian conditions. From the present study following conclusions are drawn:

1. Correlation equations have been obtained between L10 and Leq with vehicle volume, % of heavy vehicles and vehicle speed. Percentage errors between the measured and predicted volumes are quite low in general.

2. R2 value ranges from 0.1 to 0.7 for different equations of L10 and Leq for the data of 172 hrs collected on different dates and timings. As the R2 value of range 0.7 to 1.0 indicate a very good correlation between the observed and predicted data sets, the value of R2 can be improved by incorporating variations by taking number of different locations and taking more data sets.

Scope of future work:

1. All the measurements were taken at single location. If different location and timing can be taken then better results can be obtained.
2. In the present work only three parameters were included heavy vehicle percentage (P), vehicle volume (Q) and ve-

hicle speed. So, one more parameter observer distance (D) can be included in the prediction and it may give better results.

3. All kinds of vehicles (like motor cycles, mopeds, scooters, 3-wheelers, cars, mini trucks, buses, heavy trucks, construction equipments, tractors, etc.) should be included to calculate average speed of vehicles and their flow volume to give a more realistic analysis.

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