SUMMARY
Environmental noise pollution is a big threat to the health of humans in urban areas. It is more severe and wide spread than ever before, and it continuous to increase in magnitude due to increase in population growth and urbanization. Environmental noise pollution is not an entirely new phenomena but this problem has grown gradually with time. In many developing countries including India the main contribution to the environmental noise levels are vehicles. In a city with a reasonable huge traffic movement, the ambient noise levels reach to higher values, leading to numerous health problems like hypertension, frequent irritation and cardiovascular diseases and different control measures are to be taken to reduce this noise levels is by controlling the density of flow. The vehicular traffic in Indian cities is complex with heterogeneous number of vehicles. The other factors responsible for increase in noise levels is road dimensions, speed of the vehicles, the presence of reflecting and absorbing surfaces such as buildings and trees on either sides of the road. A number of noise surveys involving measurements of noise levels in urban areas by different researchers in different parts of India and world.

**Objectives of the study:**

In the present study an attempt is made in this direction at Hyderabad which is one of the major cities of India. The study was carriedout with the following objectives:

- To monitor and assessment of equivalent noise levels ($L_{eq}$) and noise indices $L_{10}$, $L_{50}$ and $L_{90}$ at different environmental backdrops of Hyderabad city i.e. residential, commercial and industrial areas.
- To estimate and assessment of noise parameters i.e. Traffic Noise Index (TNI), Noise Climate (NC) and Noise Pollution Level ($L_{np}$) for all the study locations.
- To measure hourly traffic volume of two wheelers, three wheelers and four wheelers (light & heavy) along with it measurement of noise equivalent levels ($L_{eq}$) for each study location on diurnal basis.
- To develop a road traffic noise prediction model based on the percentage of heavy vehicles and regression analysis to predict noise equivalent levels ($L_{eq}$) using Calixto model.
The present study at Hyderabad city the capital of Telangana state in which different areas were selected with diverse environmental backdrops covering both urban and industrial areas. The study locations are Marredpally a residential area, Trimulgherry a mixed (commercial and residential) area, Begumpet a commercial area and Jeedimetla an industrial area.

Noise descriptors such as $L_{eq}$, $L_{10}$, $L_{50}$, $L_{90}$, TNI (Traffic Noise Index), $L_{np}$ (Noise Pollution Level), NC (Noise climate), Q (Traffic volume) and P (Truck-Traffic Mix Ratio) are assessed to reveal the extent of noise pollution due to heavy traffic in these studied locations. A sound level meter is the fundamental instrument used to measure the noise. An Environmental sound level meter 2001(DL03) of Baseline Technologies is used. It is used to measure the existing noise equivalent level ($L_{eq}$) dB (A) at all study locations.

For this study traffic volume and noise levels were measured at different locations of Hyderabad are taken diurnal (6:00 - 5:00 hrs) sixty measurements were made for every hour duration (i.e. at one minute interval) for each month over a period of one year. The monthly averaged data is further classified into different Quarters i.e. Quarter-1 (November -February), Quarter-2 (March- June) and Quarter-3 (July-October). The noise levels were measured following standard procedure using calibrated sound level (dB) meter by keeping the sound level meter on a tripod almost to chest level (1.2m) in order to reduce errors due to reflection of sound from the body of investigator and the instrument was kept at 5m away from the roadside. Counting the number of vehicles such as two wheelers, three wheelers and four wheelers come under light vehicles while buses and trucks come under heavy vehicles and simultaneously equivalent noise levels $L_{eq}$ were recorded at each study location. Equivalent noise levels $L_{eq}$ is defined as the steady sound level that contains the same amount of acoustic energy as the fluctuating level over the prescribed period of time.

The noise indices are sound level history over a given period of time is presented in the form of a cumulative distribution. The percentile exceeded sound levels most commonly used are $L_{10}$, $L_{50}$ and $L_{90}$The noise parameters such as Traffic Noise Index (TNI), Noise Climate (NC) and Noise pollution level ($L_{np}$) were calculated by noise
indices which describe the annoyance and community noise. From the total count of vehicles the percentage of heavy vehicles was calculated.

The annual average noise equivalent levels ($L_{eq}$) are 66.3, 72.4, 76.2 and 76.9 dB (A) respectively at residential area of Marredpally, mixed area of Trimulgherry, commercial area of Begumpet and industrial area of Jeedimetla. At all the areas the annual day and night averages were 69.7 and 59.7 dB (A) for residential area of Marredpally, 77.4 and 62.5 dB (A) for mixed area of Trimulgherry, 80.3 and 68.1 dB (A) for commercial area of Begumpet and 80.5 and 69.7 dB (A) at industrial area of Jeedimetla. Peak hour analysis was done during both in morning and in evening times for all study locations.

Annual average $L_{eq}$ for all study locations at the residential area of Marredpally the noise is majorly due to residential activity and due increased usage of vehicles and also due to vendors shouting and single narrow roads making it more congested leading to frequent traffic jams which results in increase of noise levels. At the mixed area (Commercial and Residential) of Trimulgherry the noise levels are more due to increase in both residential and commercial activities, increase in use of vehicles and narrow lanes and less amount absorbers along the roads when compared to residential area of Marredpally. The study location of Begumpet the noise levels are high mainly due to more number of vehicle plying on the roads, urban activity, commercial center more number of shopping malls on the main roads and lack of parking space leads to traffic jams, sound reflectors on both sides of roads like tall building and less vegetation and frequent repairs of roads also lead to congestion. This area also connects to major parts of twin cities is also a major factor of causing noise pollution. The noise levels are increasing at a very fast rate due to the above reasons and are far off from the permissible range especially during the morning and evening peak hours. At the study location of Jeedimetla the noise is due to two factors one is due to heavy vehicles plying on the roads and other is due to industrial activity making it a more noisy area compared to all other areas.

The average equivalent noise levels ($L_{eq}$) at the industrial area of Jeedimetla is the highest 76.9 dB (A) but the commercial area of Begumpet is also not far off with a value of 76.2 dB (A). This shows that the noise levels are increasing at commercial area at a
rapid rate. The equivalent noise levels (L_{eq}) for each hour showed that noise levels started falling around midnights at all locations and reached a minimum around 03:00- :04:00 hours, when it started rising again. The equivalent noise levels (L_{eq}) for each hour at different study location showed that noise levels were maximum during morning peak hours i.e. 09:00 - 12:00 hours and during evening peak hours i.e. 17:00-20:00 hours for all study locations. In our study the equivalent noise levels (L_{eq} (L_{\text{min}}–L_{\text{max}})) showed at different locations i.e. residential area of Marredpally is ranging between 40.5 - 89.5 dB (A) while the mixed area of Trimulgherry is ranging between 43 - 100. 4 dB (A) and commercial area of Begumpet ranged between 50.5 - 106.2 dB (A) while the industrial area of Jeedimetla ranged between 53.1 - 105.7 dB (A).

In all the study locations the noise levels were high above the permissible limits as given by CPCB (2000), India. A regression analysis was done at study locations for vehicles and observed L_{eq}. Since road traffic noise is a big concern for the people living near the roadside. In the present study a mathematical model which requires total vehicle count and percentage of heavy vehicles is taken which is Calixto model for predicting noise levels and then the observed noise levels were compared with calculated/predicted noise levels L_{eq}. For validation of this a regression analysis was done for all areas and correlation coefficient R^2 was obtained. In the present study correlation coefficient R^2 values for industrial area of Jeedimetla showed the highest correlation of 0.917 whereas the mixed area of Trimulgherry also showed the best results of R^2 value of 0.913, whereas the commercial area of Begumpet showed a R^2 value of 0.827 and the residential area of Marredpally shows least correlation coefficient R^2 value of 0.817. The correlation coefficient R^2 value of 1.0 is considered to be the best fit, where as values above 0.7 is considered to be good. This shows that in all the areas the correlation is very good and the value of “r” also shows good results. From this we can conclude that the Calixto model is good for Indian road conditions. The following recommendations are made to reduce these noise levels and thereby creating good environment which further leads to good health.
- Plantation of variety trees along the roadside is one easy way which is cost effective. Vegetation buffers zones should be created at different places of the city.
- Awareness programs should be conducted for the people and vehicle drivers regarding the aftermaths or consequences of noise pollution.
- Road surface gradient (design), road usage and development of adjacent roads are also factors that influence the traffic noise.
- Making people aware of use of bicycles rather than using vehicles for smaller distances saving fuel as well as making it less pollution and promotion of more ecofriendly vehicles which can reduce noise.
- Silent zones should be created near the schools and hospitals and should be maintained properly.
- Restricting heavy vehicle movements in the city during morning hours and separate lanes should be provided for heavy vehicle if they are allowed. Special drives should be done to check the vehicles and overage vehicles should be eliminated which make more noise.
- The individual can control noise of his vehicle by proper maintenance and fitting a suitable muffler or silencer which can reduce sound. Use of unwanted horns should be avoided and using of honking horns (hydraulic) should be banned as it makes other people travelling restless.
- The windows of the houses which are nearby road should be double glazing which can reduce the levels up to 20 dB.
- There should be an increase in public mass transport especially during peak hours to avoid usage of individual vehicles which can reduce the traffic and thereby decrease the noise pollution.