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Evaluation of Varying Noise Levels with Geometric Aspects of Roads at Locations of Residential and Industrial Zones in Bengaluru Metropolitan City

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***Abstract*:- This paper describes the evaluation of varying noise levels along with geometric aspects, at 05 various locations of Bengaluru city. The real-time Noise levels are observed at 05 locations of industrial and residential zones under the present study. The annual average of noise levels varies extensively at all the stations. The increased noise levels show that the ambient noise levels are significantly high in case of residential areas when compared with the noise levels of industrial areas, concerning the norms/limits prescribed by the CPCB(Central Pollution Control Board). The current study emphasizes the assessment and study of traffic noise concerning the geometric aspects of Roads in all the study locations of Bengaluru city.**

Keywords: Noise level, Residential Zone, Industrial Zone, Day equivalent noise level.

INTRODUCTION:

Rapid globalization and urbanization lead to many environmental challenges such as air pollution, noise pollution which lead to the impact of various geometric aspects. Among all noise pollution is considered an important aspect of geometric design. Vehicular traffic is the main source for an increase in noise levels in urban areas 85% of total noise. The increasing vehicular population will increase the noise levels and associated health issues which would cause both mental and physical disorders. Noise is considered one of the major contaminants under the control and prevention of the Air Pollution Act. The World Health Organization (WHO) evaluates that 10% of the world's population is exposed to higher sound levels that could probably cause noise-induced hearing impairment. Noise causes psychological effects such as annoyance, depression, anxiety, and severe health hazards such as cardiovascular disorders.

The present work emphasizes on the impact of geometric aspects of road and traffic on noise pollution in urban area of Bengaluru city. The noise monitoring data is collected for 05 locations of Bengaluru urban city for the past 4 years 2015, 2016, 2017 and 2018. The focus on the present study is to:

- Ascertain the annual average ambient noise levels of the residential area is much more than the industrial area, in assessment with the ambient noise standards of India approved by CPCB.
- Even though the noise levels in industrial areas are contributed by both industries and vehicular traffic, the noise levels remain within the prescribed limits of CPCB.
- Analyze the L_{day} to ascertain the severity of noise levels.

AMBIENT AIR QUALITY STANDARDS IN RESPECT OF NOISE IN INDIA.

Area code	Category of area/zone	Limits in dBA Leq[a]	
		Day time	*Night time*
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Sensitive area	50	40

Table: 1 [a]Leq denotes the time weighted average of the sound level in decibels in A-weighting. [36][37]

Even though 05 study stations are inadequate to characterize the noise environment of the respective locations, it is possible to interpret the noise level of industrial and residential zones of a city. It may be noted here that the day equivalent level, L_{day} is designed from the continuous 24 hours noise data for each day of the year. The day-time is from 6.00 a.m. to 10.00 p.m., while the night period is considered from 10.00 p.m. to 6.00 a.m. The current ambient noise standards followed in our country are in terms of L_{day} and L_{night} as shown in Table 1.

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MATERIALS AND METHODS:

The noise monitoring data is acquired from the National Ambient Noise Monitoring Network (NANMN) established in the year 2011 across major cities in India for uninterrupted noise monitoring throughout the year. The 05 study points under this study constitute 2 in industrial and 3 in residential zones. [5]

Geonica Earth Sciences, Spain has installed the Noise Monitoring System which is a programmed/automatic system, comprising a sound level meter to the national standards for uninterrupted computation of the ambient noise levels through the year. In addition, a website application was developed to publish the real-time data to the community for creating awareness and reducing the noise levels/pollution in various parts of the country. The remote/distant stations collect and store the data which is then transmitted via a GPRS system to the centralized database which shows the ambient noise levels on daily basis, L_{day} value for all the 05 sites under consideration.[37]

ANALYSIS OF NOISE POLLUTION AT VARIOUS LOCATIONS OF INDUSTRIAL ZONE:

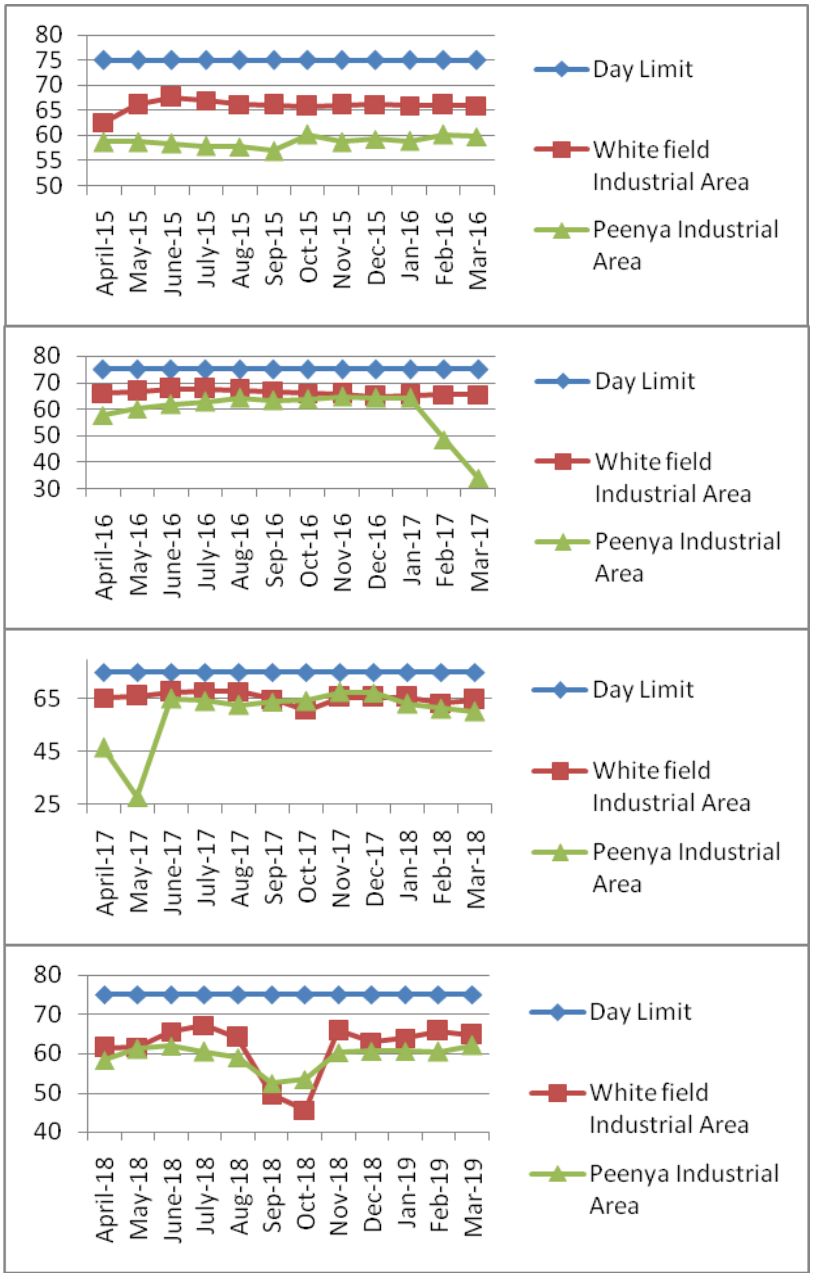

Fig 1: Monthly variation in noise levels at day time (6:00am to 10:00 pm) in industrial zone for the locations of white field industrial area and Peenya industrial area in Bengaluru city for the year 2015-16, 2016-17, 2017-18 and 2018-19.

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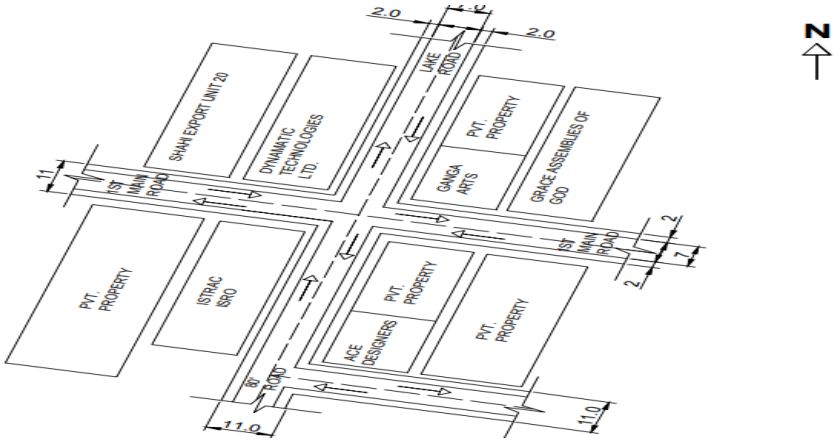

Fig 2: Peenya industrial area

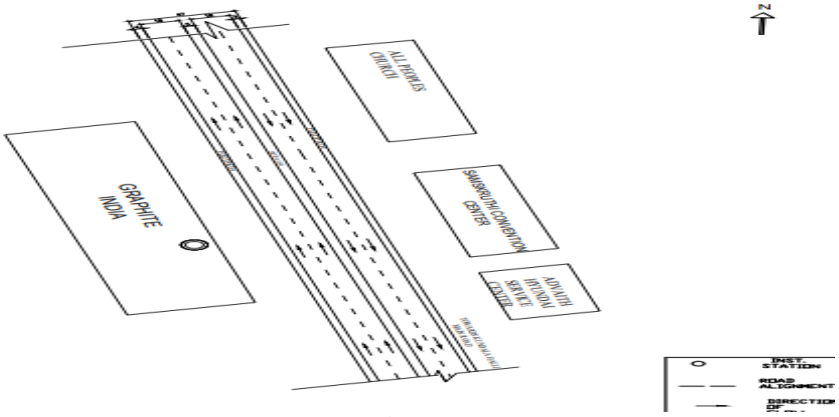

Fig 3: White field industrial area

According to the zone-based categorization of CPCB, the industrial zone is one of the zones where prominent industries of the city are located. In Bengaluru city, Peenya industrial area and white field industrial area are the two industrial stations where noise monitoring instruments are installed for monitoring the noise levels in and around the industrial area. Fig 2 and 3 show the geometrical view of the road in which the SMIs (Sound Measuring Instrument) are installed at Peenya and White field industrial area respectively. The width of the carriageway, presence of footpath, the buildings around the station point, junctions are indicated as in the site in fig 2 and fig 3.

Fig. 1 describes the variation of day equivalent noise levels for two study locations of industrial areas in Bengaluru city in the year 2015-16, 2016-17, 2017-18, and 2018-19. The observation reveals that the noise level at the white field is higher than that of the Peenya industrial area in 2015-16. The noise levels for the years 2016-17 and 2017-18 are almost equal in both locations except for February, March, April, and May 2017, where the noise levels gradually reduced in Peenya industrial area. For the year 2018-19, the noise levels vary throughout the year, but for, first four months (April, May, June, and July) and the last five months(November, December, January, February, and March), the noise levels are higher. In August, September, and October, noise levels are higher in the Peenya industrial area than White field. The maximum increase in noise levels during daytime (Lday) in Peenya industrial area is 4% from 2015 to 2019. Whereas, in white field industrial area, the variance is just around 1%, not the increase. For the past four years, ambient noise levels of the white field industrial area are more than that of the Peenya industrial area. The graphs describe/show the ambient noise levels in the industrial zone are less than the permissible day limit (75 dB).

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ANALYSIS OF NOISE POLLUTION AT VARIOUS LOCATIONS OF RESIDENTIAL ZONE:

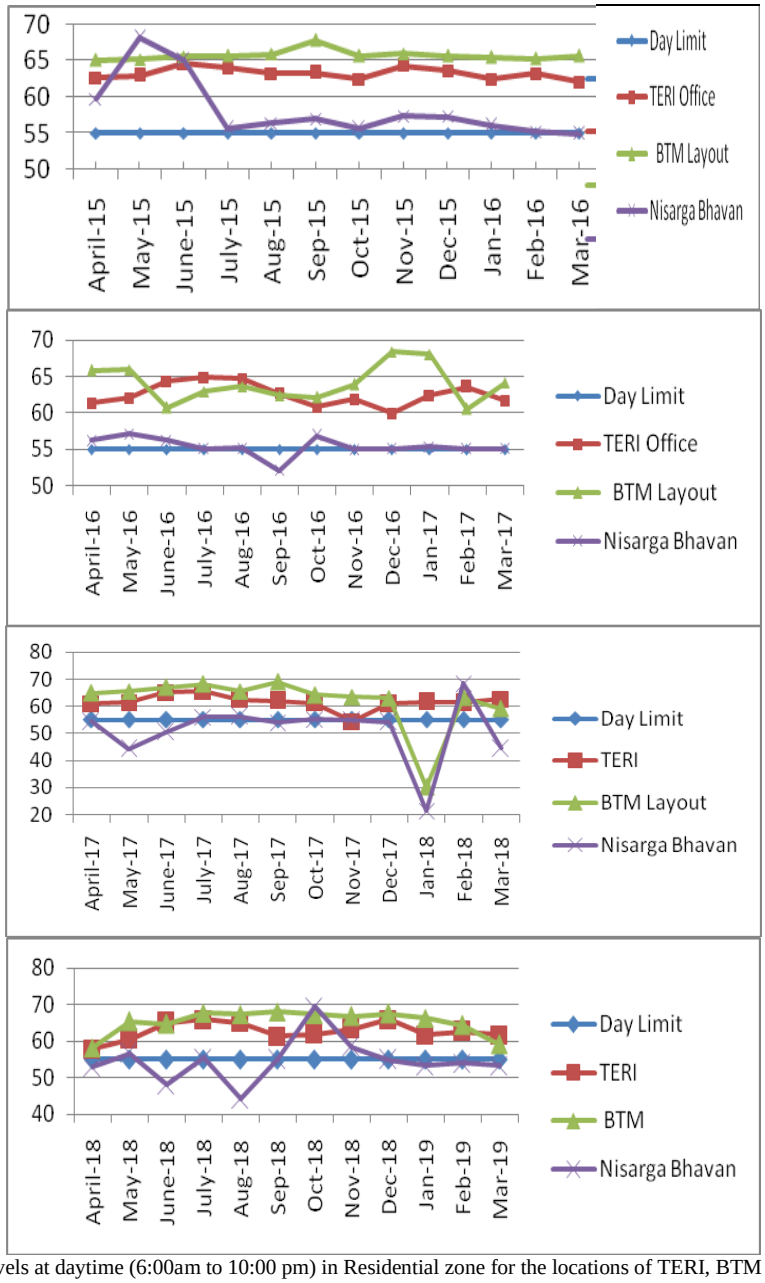

Fig 4: Monthly variation in noise levels at daytime (6:00am to 10:00 pm) in Residential zone for the locations of TERI, BTM & Nisarga Bhavana Residential area in Bengaluru city for the year 2015-16, 2016-17, 2017-18 & 2018-19.

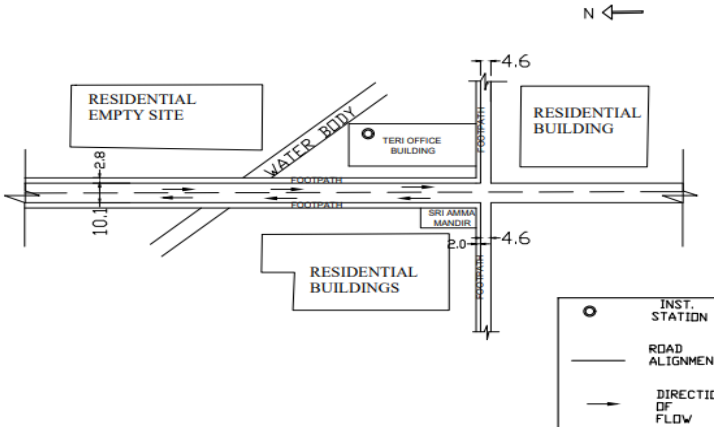

Fig 5: TERI Residential area

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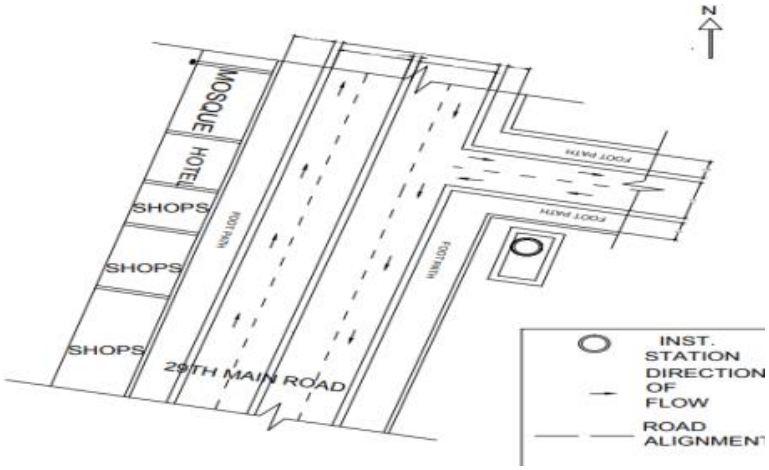

Fig 6: BTM (Madivala) Residential area

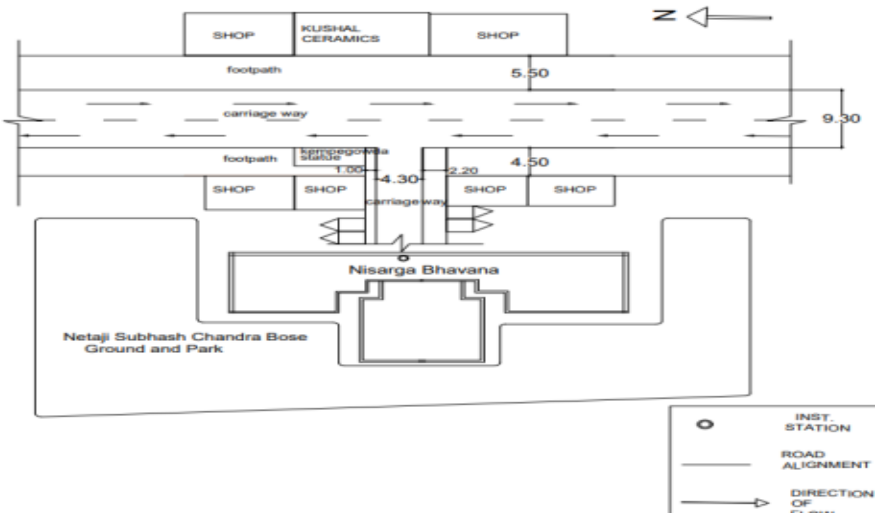

Fig 7: Nisarga Bhavana Residential area

According to the CPCB, the Residential zone is one of the zones where prominent dwellings of the city are located. Nisarga Bhavana, TERI, and BTM (Madiwala) are the three Residential areas where noise monitoring instruments are installed for the monitoring of noise levels in and around the study points. Fig 5, 6, and 7 show the geometrical view of the road in which the SMIs (Sound Measuring Instrument). The width of the carriageway, the presence of footpath, the buildings around the station point, junctions are indicated as in the site in fig 2 and fig 3.

Fig 4 describes the variation of day equivalent noise levels(Lday) for residential areas in Bengaluru city in the year 2015-16, 2016-17, 2017-18, and 2018-19. The observation says that the noise level at BTM (Madiwala) is the highest among the three stations in all the observed years as shown in fig 4 from 2015-19. The noise levels at Nisarga Bhavana in all four years are very much nearer to the Permissible day limits range(55 dB), sometimes increased and decreased marginally.TERI Residential area also showing higher than the prescribed limit.

Fig 5 clearly indicates the TERI Residential area. The SMI is located on the TERI office and is a junction where four roads meet. There is a BMTC bus stand located nearby and has got a great number of buses entering and exiting. It is entirely a residential area along with some offices and petty shops nearby. There are few high-raised buildings around which indicates the mixed zone like residential zone. Because of the above-said reasons, the movement of mixed traffic is too high along with huge vehicles like trucks and buses.

Fig 6 shows the layout of BTM(Madivala), a popular-convenient residential area near the electronics city where many big office complexes and apartments are built. The SMI is located in front of the forestry department nursery. The movement of vehicular traffic is high most of the time as the area connects the center of Bengaluru and Electronics city. Construction of the next phase of METRO is also a cause for the slow movement of traffic.

Fig.7 shows the layout of Nisarga Bhavana, which is an old and convenient residential area located near Basaweshwara nagara and saneguruvanahalli. The roads are very narrow with no scope for expansion of roads. The SMI is located on the first floor of the office of Parisara Bhavana, a unit of KSPCB. The movement of vehicular traffic is optimum almost all the time, but honking is high as the roads are narrow.

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CONCLUSION:

Industrial Zone:

- The data indicates that the Peenya industrial area has a clear geometrical design (road width, sight distance) with a good diversion of traffic for easy movement of the vehicles, whereas for the White field industrial area, the geometrics of the road is as shown in fig 3. It indicates that the road leads to other zones like residential and commercial zones and has mixed vehicular traffic. So the vehicular density and movement are more in this zone when compared to Peenya industrial area.
- Less honking in Peenya than the White field area. Mixed vehicular condition in white field industrial area, whereas less mixed traffic condition in Peenya due to the zone categorization. The industrial zone meets the ambient noise level standards. The ambient noise levels are well within the permissible day limit (75 dB) all through 2015-2019.

Residential Zone:

- Among the three study points, Nisarga Bhavana is the only residential area where the noise levels are well within the prescribed day limits (L_{day} 55dB). The graphs describe/show the ambient noise levels in the TERI, BTM, and the maximum increase in noise levels during daytime (L_{day}) in both the zones is 21-25% from the year 2015 to 2019.
- TERI Residential area is also higher than the prescribed limit. It is entirely a residential area along with some offices and petty shops nearby. So could be mentioned as a mixed zone also. Because of the above-said reasons, the movement of mixed traffic with huge vehicles like trucks and buses makes the area noisier.
- The observation indicates that the noise level at BTM (Madiwala) is the highest among the three stations in all the four observed years. The movement of vehicles is high most of the time as the area connects the center of Bengaluru and Electronics city. Construction of the next phase of METRO is also a cause for honking and slow-moving traffic.
- The noise levels at Nisarga Bhavana are much nearer to the Permissible day limits range (55 dB), sometimes increased and decreased marginally. The roads are very narrow, with no scope for expansion of roads.

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