International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES),(UGC APPROVED)
Impact Factor: 5.22 (SJIF-2017),e-ISSN:2455-2585
"International Conference on Modern Trends in Civil Engineering"(ICMTCE-2019)
(Towards Sustainable Development Goals)
Volume 5, Special Issue 02, Feb.-2019

EFFECTS OF URBAN MORPHOLOGY ON THE TRAFFIC INDUCED NOISE DISTRIBUTION THROUGH 2D NOISE MAPPING: A CASE STUDY OF OKHLA INDUSTRIAL AREA, NEW DELHI, INDIA

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Abstract

Noise pollution has been growing as one of the key factor affecting quality of life in urban areas worldwide. Traffic induced noise is typically the single largest source of noise pollution in most of the urban areas. The paper aims at to investigate the impact of urban morphology on road traffic noise distribution through 2D noise mapping. Major roads and intersections of Okhla Industrial area has been covered in the present study. The noise monitoring has been carried out at various preselected locations of Okhla Industrial Area, New Delhi, India. Thereafter, 2D noise mapping has been done using hourly average noise levels for Okhla Industrial Area Phase-I, Phase-II and Phase-III. Monitored results of noise levels indicate that the Okhla industrial area Phase-II has been more prone to noise pollution in comparison to Okhla Phase-I and Phase-III. The 2D noise maps revealed that the noise levels remain maximum at the centre of the road and reduce with the distance on either side. The reduction pattern along with noise levels can easily be visualize and evaluated by using these maps. This type of study may become imperative for decision makers during adaptation of suitable remedial measures.

Keywords: Road traffic, Noise Levels, 2D Mapping, Urban morphology

1.0 INTRODUCTION

In the recent years, traffic induced noise pollution, has been growing as one of the major factor affecting quality of life in urban areas worldwide [1-2]. The noise level in most of the densely populated cities can cause serious and long-term adverse health effect [3]. In urban areas noise may seem to be predictable and unavoidable, even the densest and active location can take steps to reduce noise [4]. Urban settings have many sources of noise; many of them more important and avoidable, sources arise from commercial and industrial activity. Traffic induced noise is typically the single largest source of noise pollution in most of the cities [5-6]. In developing countries like India, noise pollution level has been increasing in urban areas due to migration of people from rural to urban areas because of the availability of jobs. Noise maps may play important role to find the exact distribution of noise levels and critical location. Noise maps may define as the graphical depiction of the noise levels distribution and the circulation of sound waves in the surrounding of the source, for a definite period and time [7]. The noise mapping may be 1D, 2D and 3D. 2D noise mapping has been widely and successfully used for the exact distribution of noise levels in urban environment. Two-dimensional noise mapping works approximately the same manner as one dimensional noise distribution. The difference is that, in 2D noise mapping we are not looking at values along a linear path, but we are looking for the values that are sitting on a grid [8]. Pinto and Mardones has been successfully used noise maps for densely populated neighborhoods of Copacabana, Rio de Janeiro—Brazil. Through noise maps they represent the distribution and propagation of noise in nearby areas [9]. Wang and Kang used noise mapping to a comparative study between UK and China to study the effects of urban morphology on traffic noise distribution in these two countries. There study shows that that the average and minimum noise level in Greater Manchester noise samples is relatively higher than that in noise samples taken in Wuhan, China, while the maximum sound pressure level in Wuhan samples is generally higher [10]. In another study done by Law et. al., they have discussed about the Advancement of three-dimensional and Two-dimensional noise mapping in Hong Kong. They give particular attention in the distribution of noise information to the community, for public education [11]. Cho et. al., have done noise mapping using measured noise and GPS data. They have introduced a new method to simply produce a noise map using sound pressure level and GPS data simultaneously [12]. 2D noise mapping has been successfully used by many researchers to show the distribution of road traffic noise [13-17]. The literature review shows that such types of studies are lacking in urban areas of developing countries, especially, effects of urban morphology/setting in the proximity of roads, which greatly affect the distribution pattern of the noise levels.

Therefore, present study aims at to investigate the effect of urban morphology on the traffic noise distribution on either side of the urban road through 2D noise mapping.

2.0 MATERIALS AND METHOD

2.1 Study Area

Okhla industrial Area in New Delhi, India has been selected as study area for this study. It is situated at 28°32'51.7"N 77°16'07.2"E in district south Delhi. As shown in Figure-1 the Okhla Industrial area is an industrial community of South Delhi. It has been established by National Small Industries Corporation and has been remains one of the 12 such areas being developed across India to promote small industries. It has been divided into three phases Phase-I, Phase-II and Phase-III. Okhla Industrial Phase I and Phase II is one of the twenty-eight notified industrial areas of New Delhi, as per the Master Plan of 2001. However, Phase III spreads over 0.45 km^2 and is an unpretentious industrial area laid out by British architect Mr Walter George.

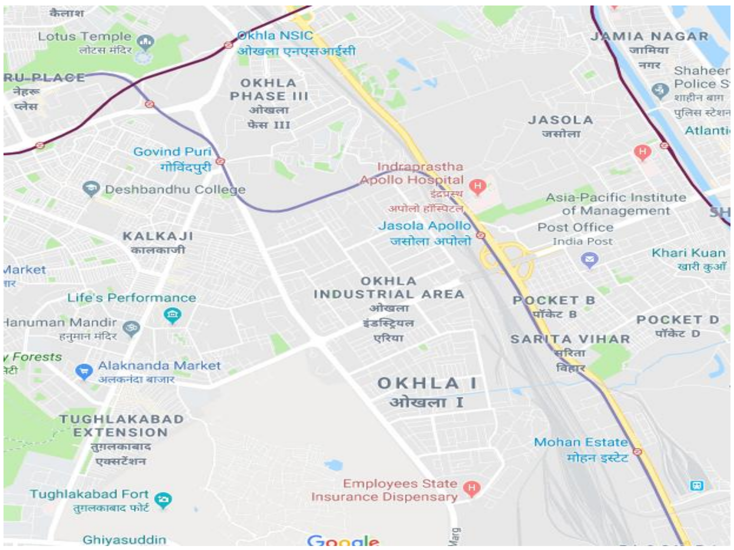

Figure.1: Okhla Industrial Area Phase-I, Phase-II and Phase-III

2.2 Noise Monitoring Instrumentation and Software

Two Sound Level Meter (Larson & Davis 831) on both side of the road has been used for hourly average noise monitoring. The Larson Davis Model-831 is a fifth generation sound level meter, use for easy single handed operation; it is completely featured, stylish and flexible with an ever intensifying firmware platform. It allows for annotative noise measurements with a voice memo via a headset plugged into the DC/AC output jack or directly through the condenser microphone.

Figure.2. Sound Level Meter (Larson & Davis 831) used for noise monitoring

Noise monitoring data has been analyzed and visualized using following software's. Which are further used for development of 2D noise maps.

1. MapInfo Pro v17
2. predictor Lim A (Desktop)

2.3 *Noise Monitoring Procedure*

Noise monitoring of study area has been done in working days only and in good weather condition. Special care has been taken into consideration for reduce the effects of wind. Two sound level meters on both side of the road has been used for noise monitoring to counter the effect of traffic flow in morning and evening. As shown in Figure- 3, sixteen temporary noise monitoring stations has been established in Okhla Industrial Area Ohase-I, eleven in Phase –II and eight in Phase-III.

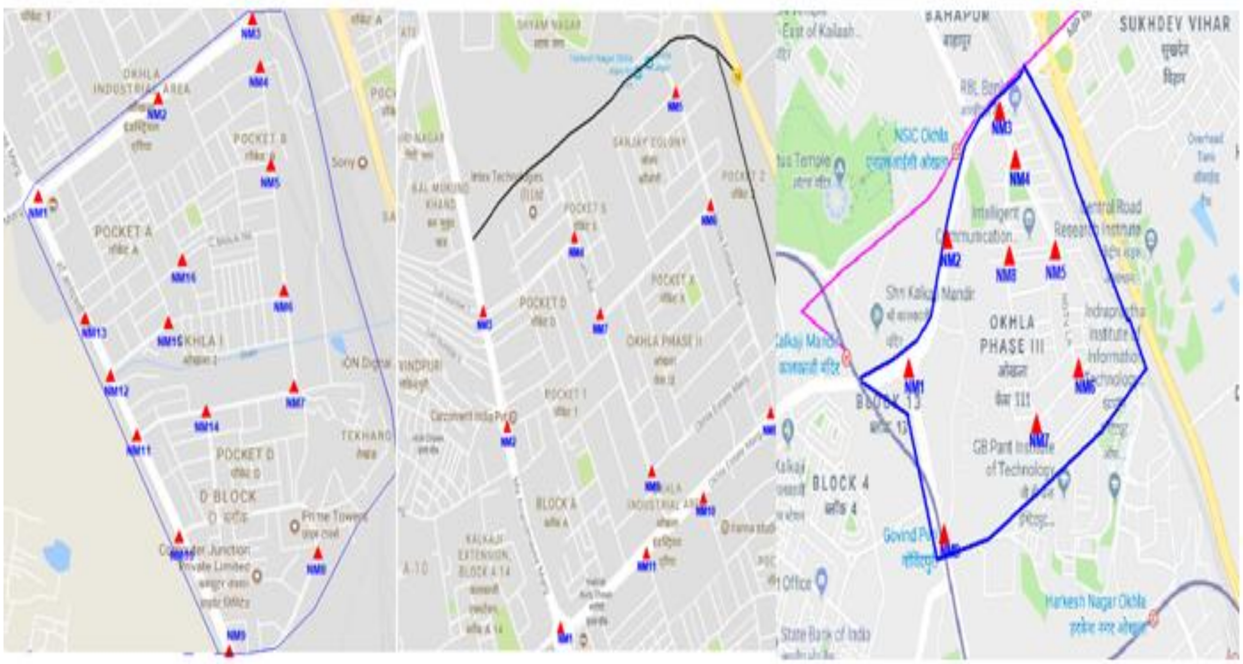

Figure.3. Temporary noise monitoring station for Hourly average noise monitoring

As shown in table. 1. Noise monitoring of Okhla Industrial Area Phase-I, Phase-II and Phase-III has been done in the month of July-2017, August-2017 and December- 2017, respectively. Hourly average Leq (A) in dB (A) has been monitored for all selected location for this study.

Table.1: Description of noise monitoring Station

S.No	Location	GPS Coordinate of sampling Location		Date	Duration
		Latitude	Longitude		
1.	Okhla Industrial Area Phase-I	28°31'27.8"N	77°16'44.3"E	03/07/17 to 01/08/17	Hr. Avg.
2.	Okhla Industrial Area Phase-II	28°32'11.2"N	77°16'27.3"E	03/08/17 to 28/08/17	Hr. Avg.
3.	Okhla Industrial Area Phase-II	28°32'56.8"N	77°16'04.4"E	18/12/17 to 03/01/18	Hr. Avg.

2.4 Noise Mapping Procedure

2D noise mapping is the pictorial representation of noise at one particular height in X and Y direction only. The step vise procedure for mapping is as follows.

- Digitalization of location map using MapInfo Pro v17.
- Demarcation of stations of noise monitoring on map.
- Hourly average data of noise monitoring in excel sheet as per the monitoring station marked.
- Attached noise monitoring data and digitalized map for prediction and 2D mapping using predictor Lim A.

3.0 RESULTS AND DISCUSSION

The phase-wise results of noise levels of Okhla Industrial Area has been presented and discussed in the following subsequent sections. Hourly variation in noise levels along with comparison with prescribed standards have also been discussed herein.

3.1 *Okhla Industrial Area Phase-I*

The trend of hourly average noise levels at Okhla Industrial Area Phase-I has been shown in figure.4. The results clearly indicate that the noise level at Okhla Industrial Area Phase-I has been observed to be within the range of prescribed standard given by Central Pollution Control Board [18]. Maximum noise level at Phase-I has been registered at 6 PM remains around 51.2 dB (A), however, the minimum remains at 12 PM, 33.1dB (A). The maximum noise level obtained may be due to evening traffic peak. The noise levels have also been compared with the prescribed standards for day time and night time and found to be within the limits. This is because of the fact that small industries along the major roads have been enclosed with walls and trees. So, major contribution of noise at Phase-I is only due to road traffic and small industries contributes very little.

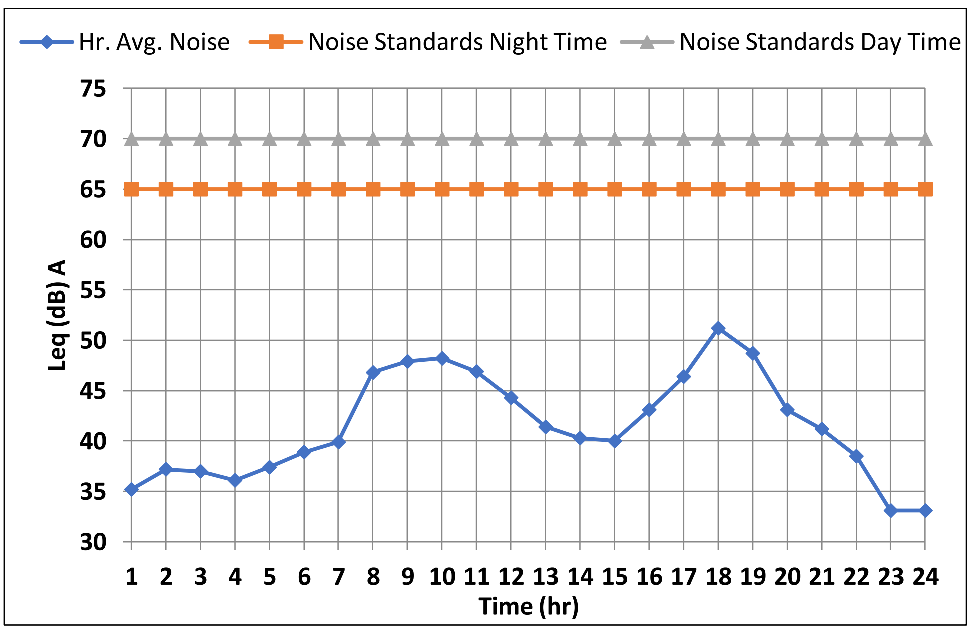

Figure.4. Variation of Leq (A) noise level at Okhla Industrial Area Phase-I

3.2 *Okhla Industrial Area Phase-II*

The fluctuation of Leq (A) noise level has been shown in Figure.5 at Okhla Industrial Area Phase-II. The noise monitoring results shows that the noise level at Okhla Industrial Area Phase-II has been remain more than the Okhla Industrial Area Phase-I but still remains within the range of prescribed standard given by Central Pollution Control Board. Maximum noise level at Phase-II has been registered at 6 PM remains around 55.4 dB (A) and minimum remains at 3 PM, 44.7dB (A). The maximum noise level at 6 PM may be due to heavy traffic volume in evening.

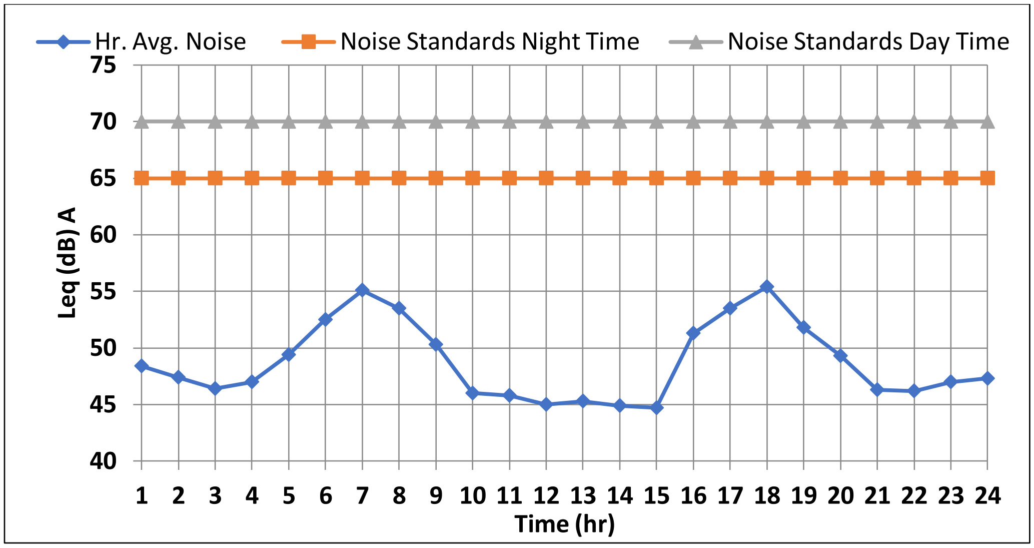

Figure.5. Variation of Leq (A) noise level at Okhla Industrial Area Phase-I

3.3 *Okhla Industrial Area Phase-III*

The variation of noise level at Okhla Industrial Area Phase-III has been shown in Figure: 6. Results clearly revealed that the noise level at Okhla Phase –III has been remain more than Okhla Phase-I but remains less than Okhla Phase-II . The maximum noise level has been registered 53.8(dB) A at 7 pm and minimum noise level remains 40.3 (dB) A at 4 pm. The Leq (A) noise level at phase-III also remains within the prescribed standard of CPCB. The comparison of noise level at day and night time also revealed that the noise level always remains within the prescribed standards. This is for the reason that the traffic volume remains minimum in Industrial Area Phase-III and industries along the roads has been enclosed with plants and walls. Only personal vehicle and vehicle playing in industrial Area for loading and unloading of materials contributes in noise pollution.

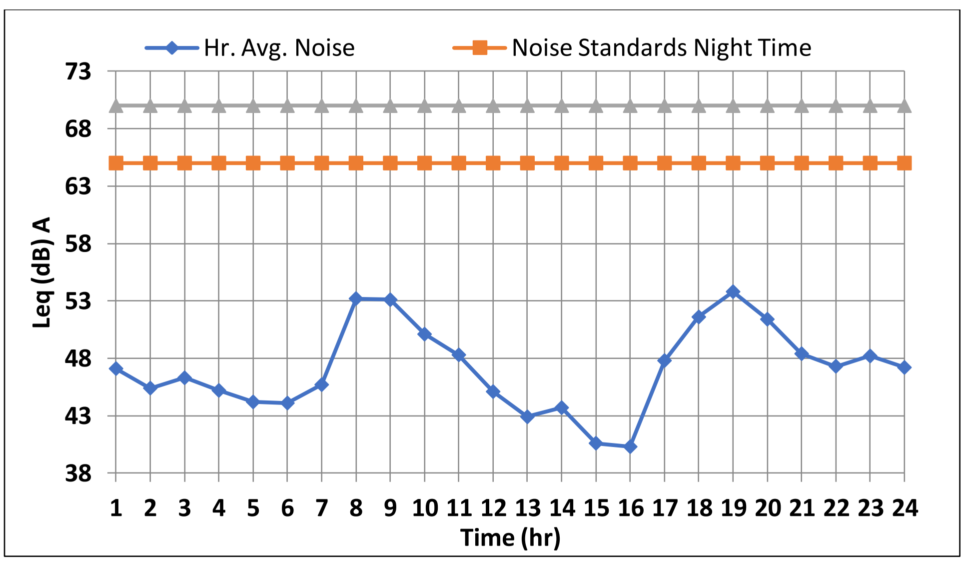

Figure.6. Variation of Leq (A) noise level at Okhla Industrial Area Phase-III

3.4 *2D Noise Mapping*

2D noise mapping of Okhla Industrial Area Phase-I, Phase-II and Phase-III have been presented and discussed in the following sections. Variation of noise level with distance along both side of the major road has also been discussed.

3.4.1 *Okhla Industrial Area Phase-I*

The 2D noise mapping for Okhla Industrial Area phase-I has been developed for peak hour only. Figure.7 shows the 2D noise map of Okhla Industrial area Phase-I. The noise map shows that maximum noise level occurs at the mid of the road and then, reduces either side. This has been decreases and reached up to 40dB (A) at a distance of 270 m and further more reduced to 20 dB (A) at a distance of 321 m from the periphery of main road.

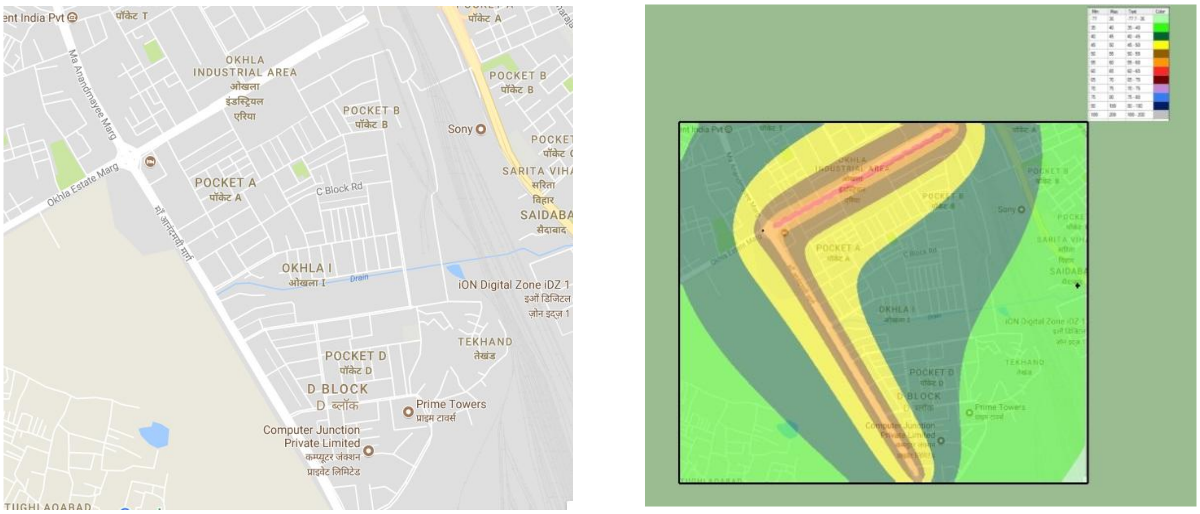

Figure.7. 2D noise mapping of industrial area phase-I

3.4.2. *Okhla Industrial Area Phase-II*

Noise map for Okhla Industrial Area phase-II has been developed only for the duration when noise level remains maximum shown infigure.8. The results shows that the noise level at Phase -II has been remain in the range of 50-55 dB (A) at the centre of the main road, slightly more than the noise level of Okhla industrial area phase-I. This has also been decreases with distance from the main road and reached up to 40 dB (A) at a distance of 180 m and further more reduced to 15-20 dB (A) at a distance of 220 m from the periphery of main road.

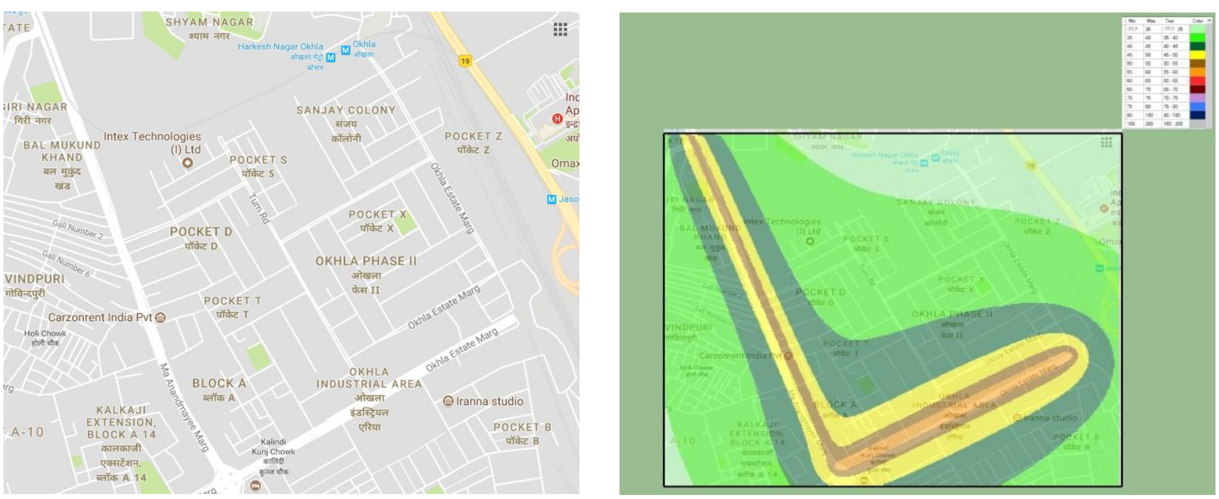

Figure.8. 2D noise mapping of industrial area phase-II

3.4.3. *Okhla Industrial Area Phase-III*

The outcome of 2D noise map shows that the noise level at Okhla Industrial Area Phase –III has been remain more than the Okhla Industrial Area Phase-I but less than the Phase-II. As shown in Figure.9 the noise level remains in the range of 50-55 dB (A) at the centre of the main road. This has also been decreases with distance from the main road and reached up to 40 dB (A) at a distance of 185 m and further more reduced to 20-25 dB (A) at a distance of 237 m from the centre of main road. The noise level at Okhla Industrial Area always remains within the prescribed standard of CPCB i.e., 70 dB (A) in day time and 65 dB (A) in night time.

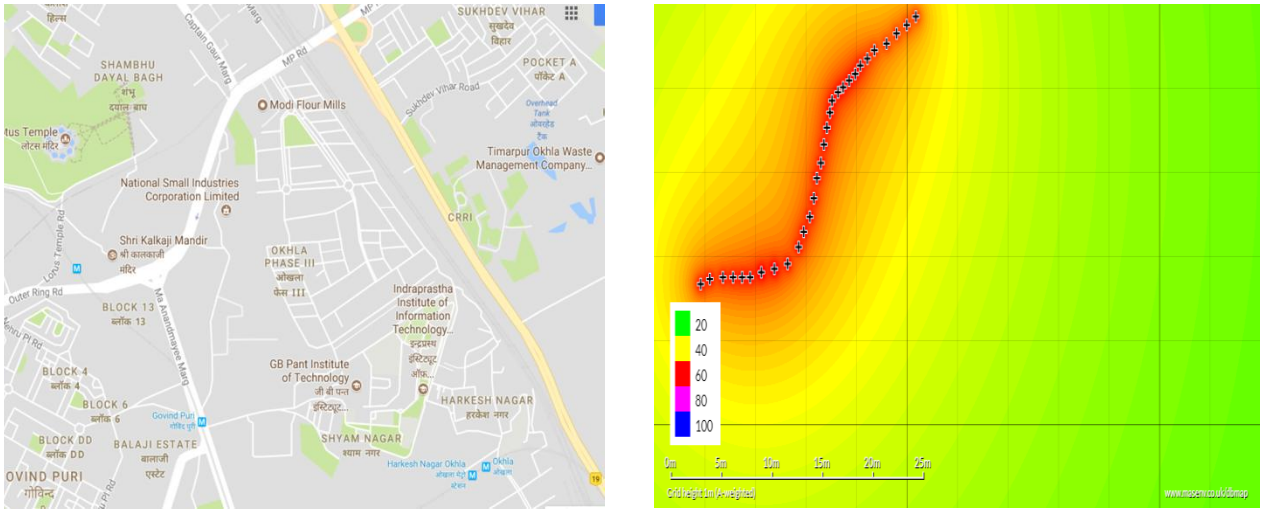

Figure.9. 2D noise mapping of industrial area phase-III

4.0 CONCLUSIONS

In this study, noise monitoring of sixteen pre-selected locations of Okhla Industrial Area Phase-I, eleven in Phase –II and eight in Phase-III have been carried out. Based on the monitoring results peak hour has been identified. 2D noise maps have been developed for peak hours to find out the effects of noise on urban morphology. The monitored results revealed that the noise level at selected locations of Okhla Industrial Area has been continuously within the prescribed standard of CPCB. This is because of the fact that the small industries along the major roads have been enclosed with walls and trees. So, minimum amount of industrial noise reached up to major roads. Only personal vehicle and vehicle playing in industrial Area for loading and unloading of materials contributes in noise pollution. The maximum noise level has been observed at Okhla Industrial Area Phase-II [55.4 dB (A)] at 6 PM and minimum has been found at Phase-I [33.1 dB (A)] at 11PM. Variation of noise levels along both side of road has been shown by 2D noise mapping. It revealed that the noise level along the center line of the road remains maximum and reduce either side with distance. Hence it has been concluded that the noise level is not a serious problem in Okhla industrial area but care for noise reduction must be developed for Okhla industrial Area Phase-II as noise levels near major road of Phase-II has been remain very near to prescribed standard of CPCB. 2D noise mapping is also an effective method for determination of the noise level distribution with distance of any area.

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