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Assessment and Appraisal of Morning Peak Time Urban Road Traffic Noise at Selected Locations of Major Arterial Roads of Surat City, India

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Abstract: Urban traffic noise is emerging as a crucial problem in the 21st century. Variation in the level of noise from urban traffic causes several health-related issues. This study demonstrates the noise assessment and appraisal of morning peak time urban road traffic noise at selected locations of major arterial roads of Surat city. The noise is compared against the norms and standards given by the noise pollution (Regulation and Control) Rules, 2000. MoEF&CC has published the Ambient Air Quality Standards in respect of noise under Rule 3(1) and Rule 4(1) as per Schedule in the annexe. In this research work, noise levels were measured at four different locations from Athwa line chowk to Dumas Road of Surat city. Traffic count has been done by calculating the numbers of two wheelers, three-wheelers, four-wheelers, and heavy vehicles (bus & truck). The A-weighted sound level was 78.9 dB(A) near the urban road, which exceeds the standard value recommended by CPCB. The maximum equivalent noise level was 114.9dB at Sushrut hospital, while the minimum was 46.1 dB at Keval chowk. Finally, the study indicates an increment in noise levels with an increment in the count of vehicles. The factors causing the increased noise levels are traffic flow, horn honking, lane indiscipline, heterogeneous traffic condition, morning rush, etc.

Key words: Noise assessment, noise levels, urban road traffic noise, traffic volume count.

Introduction

This study focussed on the road traffic noise in the urban sector, which is arising as a major issue (Ranpise et al., 2021). Urban road traffic noise is a mixture of engine noise, tire-pavement interaction noise, honking of the horn, braking noise, rolling noise, noise from acceleration and deceleration, etc. (Kumar et al., 2014a; Vijay et al., 2015). Noise from tire-pavement interaction is the major contributor to road noise generation (Ranpise et al., 2021).

It is well known that noise exposure is related to profound health impacts such as hearing loss, mental disorders, sleep disturbance, and psycho-physiological issues (Tao et al., 2019; Zannin et al., 2018). Noise may affect work efficiency and create annoyance in the ambient environment (Toppila et al., 2009). Increasing noise levels is significantly impacting the human habitat, especially in urban areas. Urban noise is incresing day by day making it a major concern for the policymakers (Swain et al., 2014). The study of urban road traffic noise and its impact on road users and roadside dwellers are significant nowadays (Kim et al., 2012). Surveys on noise levels perfomed in India's different cities reveal that street traffic is the prevalent source of adverse impacts (Mishra et al., 2010). The increment in numbers of private vehicles, horn honking, and indiscipline are significant sources of noise pollution in urban areas.

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On this account, an attempt has been made to study the equivalent noise levels at four major circles and chowk of Surat city during the morning peak period.

Materials and Methodology

Study Area

Surat city is one of the fastest-growing cities in India with a high rate of development. Various business hubs and textile markets are situated in the city, located over the western part of India. In this study, one arterial road (Athwa-Dumas road) has been selected, which is significantly connected to the various commercial and business centres and roadside dwellers. The measurement of traffic noise was carried out in the morning peak period at four different locations of Surat city. The noise monitoring points cover arterial and sub-arterial roads, including circles and chowks. These positions' choices arose because they have vast volumes of road traffic despite being a sensitive zone. Each site consists of multilevel buildings, shops, bus stops, service roads, schools, and colleges. There were free flow and non-free flows of traffic at these places. Moreover, these sites had uneven terrain where environmental influences were present.

Field Measurements

For this study, KIMO DB300 sound level meters were used for onsite noise measurement and LDB23 software to read the output. The reason for road traffic noise observation at the four areas was to get noise level data that was represented for each site. The sound level meter was compact and stood 1.5-2.0 m away from the line of traffic. A microphone was kept 1.5 m above the ground surface and away from any reflective surfaces. The traffic volume was measured and classified manually for the main road and service road for four hours.

Indian Noise Standards and Policy

The ambient air quality norms regarding noise for various zones are categorised below and are further specified for daytime and nighttime.

- Day time shall mean from 6.00 am to 10.00 pm
- Nighttime shall mean from 10.00 pm to 6.00 am
- dB(A) Leq denotes the time-weighted average of the level of sound in decibels on scale A, which is relatable to human hearing. Table 1 shows the ambient air quality standard in respect of noise given by the CPCB India.

Table 1: Indian ambient air quality standards in respect of noise

Area Code	*Category of Area/ Zone*	*Limits in dB(A) Leq **	
		Day Time	*Night-time*
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Results and Discussion

Traffic volume study includes measuring the total count of two-wheelers, three-wheelers, four-wheelers, and others as heavy-duty vehicles (H.V.). The width of the main road was 9 m and the service road was 4 m. Relative humidity was monitored, and it was 34% on average, and the temperature was nearly 32°C. No precipitation was there at the time of measurement, and the average wind speed was found to be 20 km/hr.

The uniquely prepared table provides all details in a single view; this includes geometrical features of roads, traffic count, vehicle speed, equivalent noise levels concerning time is as under.

On monitoring point 1, the noise level from 11 am to 1 pm was found to be higher than the first two hours (9 am to 11 am) of the morning peak period by almost 79 dBA. It is also observed that Leq of the morning peak hours surpassed the acceptable noise level of 65 dB(A). Table 2 provides the information about traffic volume count and noise levels with respect to time at Sushrut Hospital Surat.

At the morning peak, the maximum noise level was 72.5 dBA, which was from 10 am to 11 am. Table 3 provides the information about traffic volume count and noise levels with respect to time at Kargil Chowk, Surat. The lowest minimum noise level was 66.8 dBA at Kargil chowk during the morning peak. Also, it can be noticed that the traffic noise level increases with the increment of the number of vehicles between the period of 9 am to 11 am, which is the opening time of offices and all commercial activities. Meanwhile, noise levels were observed to be decreasing with the number of vehicles as the clock ran towards the afternoon period. Figure 2 indicates that noise level at Kargil chowk was very high and it was 72.3 dB(A).

Figure 3 shows that the noise level is increasing along with the increment of the number of vehicles,

and it is decreasing with the decrement of the number of vehicles. From 11 am to 12 pm, the Leq was 72.0 dBA and the total vehicle count during this single hour was 1702 vehicles per hour. The above mentioned charts, indicate that the count of two wheeler is more as compared to other type of vehicles which could be the main contributor in total environmental noise. Table 4 provides the information about traffic volume count and noise levels with respect to time at Keval Chowk, Surat.

The graphical representation shows the number of two-wheeler, three-wheeler, four-wheeler, and heavy vehicles, which significantly contribute to noise pollution. In this graph, vehicles were plotted against the time of monitoring.

The maximum traffic count was at 5603 vehicles per hour during the morning peak (9 am to 10 am), and it was on the Athwa gate circle with a corresponding noise level of 77.0 dB(A). In comparison, the minimum traffic count was 3320 vehicles per hour during morning time (11 am to 12 pm) at Kargil Chowk, with a corresponding noise level of 66.8 dB(A). Table 5 provides the information about traffic volume count and noise levels with respect to time at Athwa gate circle Surat.

Out of all four locations, maximum heterogeneity was seen at all four locations at the Athwa gate circle. Figure 4 represents the noise levels and traffic composition at Athwa gate circle Surat.

From the traffic survey, it is clearly understood that the two-wheelers are contributing maximum (above 60%) to the development of equivalent traffic noise levels for each of the four monitoring points. Figure 1 indicate that noise level between 11.00 am to 12.00 pm was very high and it was 79dB (A).

Table 2: Traffic volume count concerning the time at Sushrut hospital

Location 1: Suhrut Hospital

Time Interval	*Equivalent Noise Level (dBA)*	*Volume Count (Nos.)*				*Avg. Speed (km/ hr.)*				*Avg. Building height (meter)*	*Road width (meter)*
		2-w	**3-w**	**4-w**	**H.V.**	**2-w**	**3-w**	**4-w**	**H.V.**		
9.00 am-10.00 am	76.5	2270	410	1450	50	44	33	52	38	12	18
10.00 am-11.00 am	77.8	1660	360	988	49	59	34	46	36	12	18
11.00 pm -12.00 pm	78	2670	440	1396	47	46	33	45	39	12	18
12.00 pm - 1.00 pm	78.4	2610	392	1400	48	43	36	40	35	12	18

Table 3: Traffic volume count concerning the time at Kargil chowk

Location 2: Kargil chowk

Time Interval	*Equivalent Noise Level (dBA)*	*Volume Count (Nos.)*				*Avg. Speed (km/ hr.)*				*Avg. Building height (meter)*	*Road width (meter)*
		2-w	**3-w**	**4-w**	**H.V.**	**2-w**	**3-w**	**4-w**	**H.V.**	30	12
9.00 am-10.00 am	70.9	1795	277	890	22	42	33	44	26	30	12
10.00 am-11.00 am	72.5	1596	281	920	26	40	35	45	28	30	12
11.00 pm -12.00 pm	66.8	1789	299	1210	22	38	30	44	30	30	12
12.00 pm - 1.00 pm	69.8	1490	280	1180	22	36	30	43	30	30	12

Table 4: Traffic volume count concerning the time at Keval chowk

Location 3: Keval chowk

Time Interval	*Equivalent Noise Level (dBA)*	*Volume Count (Nos.)*				*Avg. Speed (km/ hr.)*				*Avg. Building height (meter)*	*Road width (meter)*
		2-w	**3-w**	**4-w**	**H.V.**	**2-w**	**3-w**	**4-w**	**H.V.**	18	12
9.00 am-10.00 am	71.8	850	161	510	24	30	19	24	19	18	12
10.00AM-11.00AM	70.9	940	176	398	16	28	19	26	18	18	12
11.00 PM -12.00PM	72	1020	167	499	16	28	18	23	18	18	12
12.00 pm - 1.00 pm	69.8	980	168	501	19	26	20	22	18	18	12

The highest noise level (Leq) measured over all four locations roads is 78.9 dB(A), which was seen during morning peak hour (11am-12pm) at Athwa gate circle. On the other hand, the minimum noise level was 66.8 dB(A) from (11 am to 12 pm), which is still more significant than the allowable noise level of 65 dB(A).

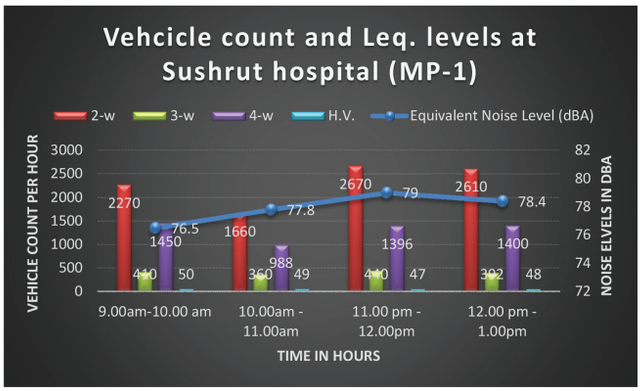

Figure 1: Vehicle count and equivalent noise at monitoring point 1.

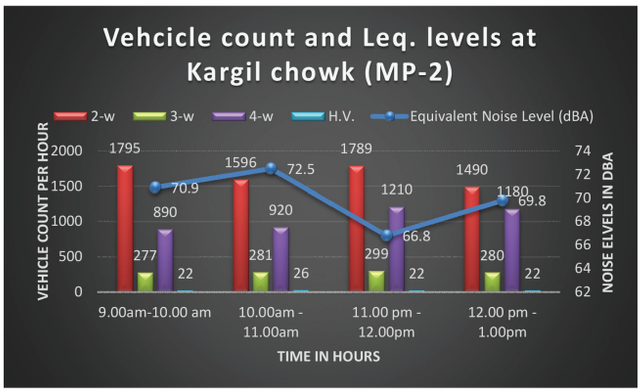

Figure 2: Vehicle count and equivalent noise at monitoring point 2.

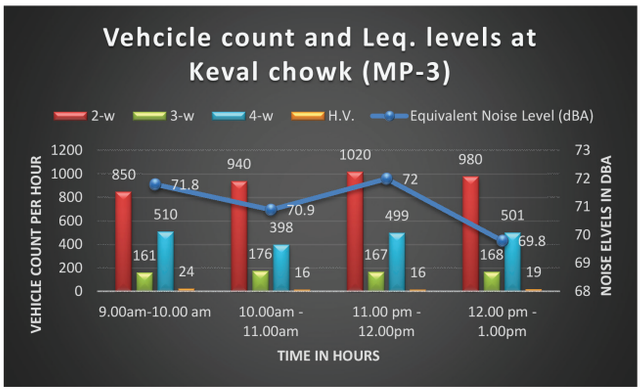

Figure 3: Vehicle count and equivalent noise at monitoring point 3.

The highest noise level (Lmax) measured across all three roads is 114.9dB(A). It was during the morning peak period (11 am to 12 pm), while the minimum noise level (Lmin) measured across all four locations was 46.1 dB(A). Figure 5 provides the location wise noise levels with respect to time also the Leq, Lmax and Lmin at all locations.

From the above results, it can be understood that the noise levels increase with increasing numbers of vehicles, especially two-wheelers. The maximum noise level was found from 9 am to 11 am and it was beyond the norms given by CPCB. Thus, exposure to high noise possesses various auditory and non-auditory effects on exposed persons. Noise-induced hearing impedance is generally characterised as an increase in the hearing limit and the most common irreversible occupational risk. Exposure of noise causes sleep disturbance, hindering execution and causes physiological initiation, including increased pulse and circulatory strain and peripheral vasoconstriction (Konbattulwar et al., 2016; Lee et al., 2019).

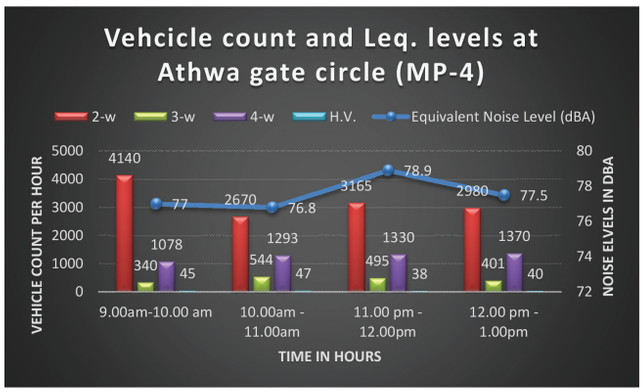

Figure 4: Vehicle count and equivalent noise at monitoring point 4.

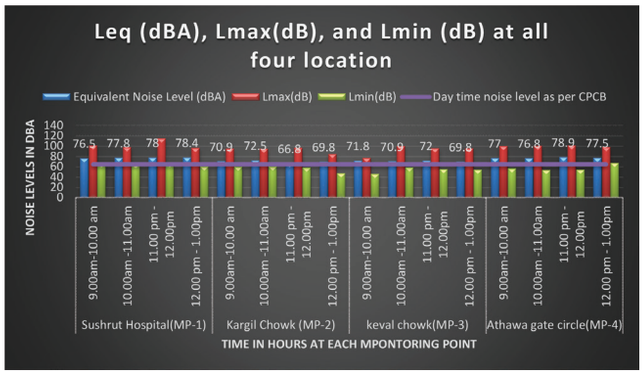

Figure 5: Noise level variations at different monitoring points at four specified time intervals in dBA.

Table 5: Traffic volume count concerning the time at Athwa gate circle

Location 4: Athwa gate circle

Time Interval	*Equivalent Noise Level (dBA)*	*Volume Count (Nos.)*				*Avg. Speed (km/ hr.)*				*Avg. Building height (meter)*	*Road width (meter)*
		2-w	**3-w**	**4-w**	**H.V.**	**2-w**	**3-w**	**4-w**	**H.V.**		
9.00 am-10.00 am	77	4140	340	1078	45	32	25	30	22	35	14
10.00 am -11.00 am	76.8	2670	544	1293	47	32	24	30	24	35	14
11.00 pm -12.00 pm	78.9	3165	495	1330	38	30	25	32	20	35	14
12.00 pm - 1.00 pm	77.5	2980	401	1370	40	30	25	30	18	35	14

Table 6: Maximum and minimum equivalent noise level, and Equivalent noise level (Leq) in dBA for morning peak period at all four locations

Monitoring point	*Time Interval*	*Equivalent Noise Level (dBA)*	L_{max}*(dB)*	L_{min}*(dB)*	*Day time noise level as per CPCB*
Sushrut Hospital (MP-1)	9.00 am-10.00 am	76.5	101.4	66.7	65
	10.00 am -11.00 am	77.8	97.7	65.2	65
	11.00 pm -12.00 pm	78	**114.9**	**67**	65
	12.00 pm - 1.00 pm	78.4	**96.4**	**60.4**	65
Kargil Chowk (MP-2)	9.00 am-10.00 am	70.9	95.5	60	65
	10.00 am -11.00 am	72.5	94.9	60.4	65
	11.00 pm -12.00 pm	66.8	**96.5**	**58.3**	65
	12.00 pm - 1.00 pm	69.8	84.7	47.4	65
Keval chowk (MP-3)	9.00 am-10.00 am	71.8	77.2	46.1	65
	10.00 am -11.00 am	70.9	**100.1**	**58.6**	65
	11.00 pm -12.00 pm	72	95.9	55.6	65
	12.00 pm - 1.00 pm	69.8	95.7	54.3	65
Athawa gate circle (MP-4)	9.00 am-10.00 am	77	100.1	**56.8**	65
	10.00 am -11.00 am	76.8	**100.8**	53.6	65
	11.00 pm -12.00 pm	78.9	101.5	54.3	65
	12.00 pm - 1.00 pm	77.5	98	**67.6**	65

Conclusion and Recommendation

Noise levels were assessed and analysed at four locations of Surat city in the morning peak period. Table 6 gives the maximum and minimum equivalent noise level at all locations. It was seen that equivalent noise levels at all four locations are almost above 70 dBA.

This study distinctly indicates that the levels of noise at all locations are beyond the daytime noise level limits provided by the Central Pollution Control Board, India. The word "morning peak period" is a term used when most of the employees and people are travelling towards their office locations also in that selected locations commercial as well as institutional buildings are situated, so this could be the reason for dense traffic leading to high noise levels at this particular time in this area. The maximum and minimum noise levels amongst all four roads were 78.9 dB(A) and 66.8 dB(A), respectively. The significant finding is that the equivalent noise levels are nearly the same for MP-1 and MP-4. The reason could be these locations are significantly connected with arterial and subaerial roads of Surat city.

Based on the above graphs, it is clearly understood that variation of equivalent traffic noise level regarding the increase in vehicle count, especially two-wheeler, is more responsible (Kumar et al., 2014b; Shukla et al., 2009).

Industrialisation and urbanisation are the main reason for the enormous increase of private vehicles, ultimately causing increased urban traffic noise levels. Strict action should be taken from the competent authorities like municipal corporations, town planning authorities, and road traffic offices to overcome this issue (Ministry of Environment and Forest, 2000; Pandya, 2001). The competent authorities should provide strict public awareness programmes to use more public vehicles instead of private vehicles. Maximum plantation of trees along the roadside, lane discipline, public transport should be done, avoiding displeasing honking, and public awareness can help mitigate urban traffic noise (Lacasta et al., 2016; Mishra et al., 2010; Yadav and Tandel, 2020).

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