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Effect of Traffic Volume and Speed on Noise Level Under, Interrupted and Uninterrupted Traffic Flow Condition - A Case Study on NH – 7

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Abstract: ***Noise is a disturbance to the human environment that is escalating at such a high rate that it will become a major threat to the human beings. Traffic related noise pollution accounts for nearly two thirds of the total noise pollution. Traffic noise from highways creates problems for surrounding areas, especially when there is a high traffic volume and speed. The present study emphasis on the effect of traffic volume and speed under interrupted and uninterrupted traffic flow conditions. It was observed from the analysis that noise level at both traffic flow conditions were within the permissible limits. The influence of volume on noise level shows that noise levels is higher under interrupted traffic flow condition and similarly for speed on noise level indicate that the noise level is higher on interrupted traffic junction than uninterrupted junction.***

Keywords: Traffic noise, Noise pollution, Sound level meter, Acoustic equivalence

1. Introduction

Noise can be defined as the sound which exceeds the acceptable level and creates annoyance. The major sources of noise are industrial noise, traffic noise and community noise. Out of the above three noises the source that affects the most is the traffic noise, almost 70% of noise is contributed by vehicle noise. The recognition of vehicle traffic noise is one of the main sources of environmental pollution. Due to increase in population, urbanization and rapid industrialization there is a huge increase in the vehicular population on the urban corridors which has made traffic problems more complicated. Traffic noise from highways creates problems for surrounding areas, especially when there is a high traffic volume and speed. So the present study was carried out analyse the effect of traffic volume and speed on noise level.

2. Study Area

Hosur is located on the National Highway -7 between Krishnagiri (Tamilnadu) and Bangalore (Karnataka). It is located about 40 kilometres south-east of Bangalore and 49 kilometres from Krishnagiri. It is connected by Expressway to Bangalore on one side and Chennai and Salem on the other side. The latitude and longitude of Hosur lies between $12^{o}\ 43^{'}\ 0^{"}$ N / $77^{o}\ 49^{'}\ 0^{"}$ E. It is an industrial hub for several Industries which have their manufacturing units at Hosur thereby increasing the traffic users day-by-day. Figure 1 shows study area Map of NH-7 between Krishnagiri and Bangalore

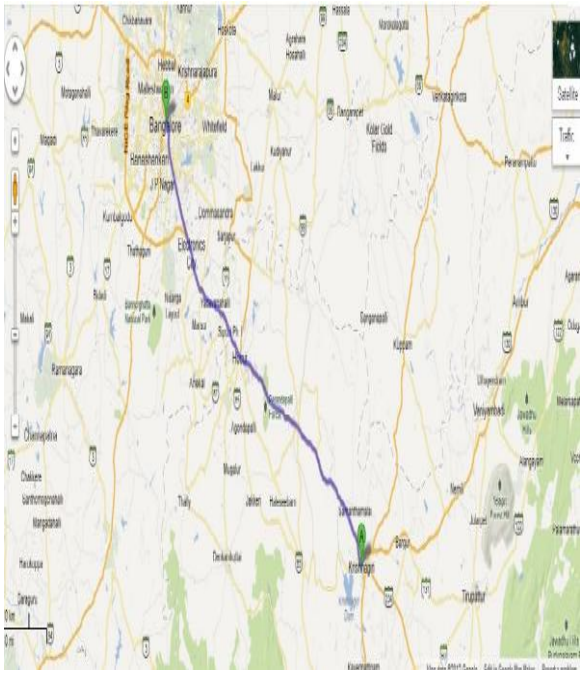

Figure 1: Study Area Map

3. Materials and Methodology

To study the effect of traffic volume and speed on noise level, The traffic volume, speed and noise level were measured at the study locations during different intervals of time (8 a.m-10 a.m&1p.m – 3p.m&5p.m – 7p.m) for a period of one week on NH -7. The study locations under both interrupted and uninterrupted traffic flow conditions were identified. The study locations under, interrupted flow are Rayakotta Bye pass, Dharga Check post and Ring road junction and locations under, uninterrupted flow are Perandapalli, Gopuchandra, and Kamandoddi. Traffic volume studies were conducted by using manual count to collect data on the number of vehicles that pass a point at the

selected location. Speed for each category of vehicles was recorded in a separate form by using a hand held Radar gun measured in kmph. Noise level was measured using sound level meter placed on a tripod at a height of about 1.20 m above the existing road level at distance of 1.50 m from the existing road edge on both sides of the road. The noise measurements recorded are L_{eq} , L_{10} , L_{max}, L_{min}, Where, L_{eq} is the equivalent continuous noise level in dB(A). L_{10} is the level exceeded for 10% of the measurement time respectively, L_{max} measured gives the idea about maximum noise levels measured and L_{min} represents the minimum noise levels measured.In order to quantify the noise level of individual vehicles, field studies were conducted at the study locations to record the noise level .Based on the noise level and homogeneity, vehicles have been classified into six categories according to (Jain etal) i) Car/ Jeep/ Van, ii) Two Wheelers/Scooter/Motor Cycles), iii) Light commercial vehicle / Minibus, iv) Auto rickshaw, v) Bus and vi) Truck.

4. Results and Discussion

In this study, Analysis of observed Traffic noise, Traffic volume and Speed was done separately for uninterrupted and interrupted traffic flow conditions to understand the variation of traffic noise, volume and speed study area.

The composite relationship is then developed based on factor of acoustic equivalence between the different vehicle classes are determined

$E_{VehicleConsidered} = 10^{(\text{Mean of vehicle considered- Mean of reference vehicle})/10}$

$E_{Truck} = 10^{(79.75-69.50)/10} = 10.59$

$E_{Bus} = 10^{(78.50-69.50)/10} = 7.9$

$E_{Auto} = 10^{(75.42-69.50)/10} = 3.9$

$E_{LCV/\ MB} = 10^{(73.82-69.50)/10} = 2.7$

$E_{TW} = 10^{(71.42-69.50)/10} = 1.55$

Where,

E_{Truck}indicates that the noise level produced by one truck is equivalent to the 10.59 times Car/ Jeep/ Van, Similarly, E_{Bus}, E_{Auto}, $E_{Lcv/m,}$ E_{TW} indicate that the noise emitted by one Bus, Auto rickshaw, Lcv/mb and Two wheeler is equivalent to 7.9, 3.9, 2.7 and 1.55 Car/ Jeep/ Van respectively.

The total equivalent road traffic volume is then calculated by,

$Q_E = Q_{Car/Jeep/Van} + E_{Tru}Q_{Truck} + E_{Bus}Q_{Bus} + E_{Auto}Q_{Auto} + E_{LCV/MB}\ Q_{LCV/MB} + E_{TW}\ Q_{TW}$

$Q_E = Q_{Car/Jeep/Van} + 10.59Q_{Truck} + 7.9\ Q_{Bus} + 3.9\ Q_{Auto} + 2.7\ Q_{LCV/MB} + 1.55\ Q_{TW}$

$S_E = [Q_{Car/Jeep/Van}\ S_{Car\ /Jeep/Van} + 10.59\ Q_{Truck}S_{Truck} + 7.9Q_{Bus}S_{Bus} + 3.9\ Q_{Auto}S_{Auto} + 2.7\ Q_{LCV/MB}\ S_{LCV/MB} + 1.55Q_{TW}\ S_{TW}\ ]/\ Q_{E.}$

Where,

E_{Tru}, E_{Bus}, E_{Auto}, $E_{LCV/MB}$ and E_{TW} are the acoustic equivalence factor for Trucks, Bus, Auto rickshaw, LCV/MB and Two wheelers respectively.

Q_E is the total hourly equivalent traffic volume in vehicles per hour.

$Q_{Car/Jeep/Van}$, Q_{Truck}, Q_{Bus}, Q_{Auto}, $Q_{LCV/MB}$ and Q_{TW} are the hourly traffic volume for Car/Jeep/Van, Trucks, Bus, Auto rickshaw, LCV/MB and Two wheelers, respectively

The total equivalent road traffic speed is then calculated by, S_E is the equivalent speed of traffic in kmph.

$S_{Car/Jeep/Van}$, S_{Truck}, S_{Bus}, S_{Auto}, $S_{LCV/MB}$ and S_{TW} are the mean speed in kmph for Car/Jeep/Van, Trucks, Bus, Auto rickshaw, LCV/MB and Two wheelers respectively.

Field data of individual vehicle noise and speed relationship for classified vehicles is shown in Table1.

Table 1: Field Data of Individual Vehicle Noise and Speed Relationship For Classified Vehicles

Vehicles classes		Speed (km/hr)		L_{eq} (1 hr), dB (A)		
Type	Number of vehicles	Max	Min	Max	Min	Mean
Car/ jeep/ Van	363	91.34	34.42	76.24	58.66	69.50
Two wheelers	457	80.12	30.75	84.50	64.24	71.42
LCV/ Mini bus	93	84.32	18.80	86.42	66.42	73.82
Auto rickshaw	21	66.42	16.24	88.34	63.12	75.42
Bus	63	74.50	23.12	92.75	67.48	78.50
Truck	170	61.24	19.75	94.50	68.12	79.75
Total	1167					

Analysis of Traffic Noise, Traffic Volume and Speed at Uninterrupted Flow Conditions

Traffic noise was recorded for varying traffic situations at each of uninterrupted traffic flow location along with other required traffic data. The percentage distribution of different types of vehicles at the study locations of uninterrupted traffic flow is given in Table 2 and Fig 3. From the results it can be observed that percentage distribution of different category of vehicles during uninterrupted traffic flow conditions varied from 21-34% for Two Wheelers, 1-2% for Auto, 28-36% for Car/Bus/Van, 5-7% for Bus, 10-14% for LCV/MB, 20-25% for Trucks.

Table 2: Percentage Distribution of Classified Vehicles under Uninterrupted Traffic Flow Conditions

Study Location	*Percentage Distribution Of Classified vehicles*					
	TW	Car/Jeep/ Van	Auto	LCV/ MB	Bus	Truck
1	34	28	2	11	5	20
2	21	36	2	10	6	25
3	23	34	1	14	7	21

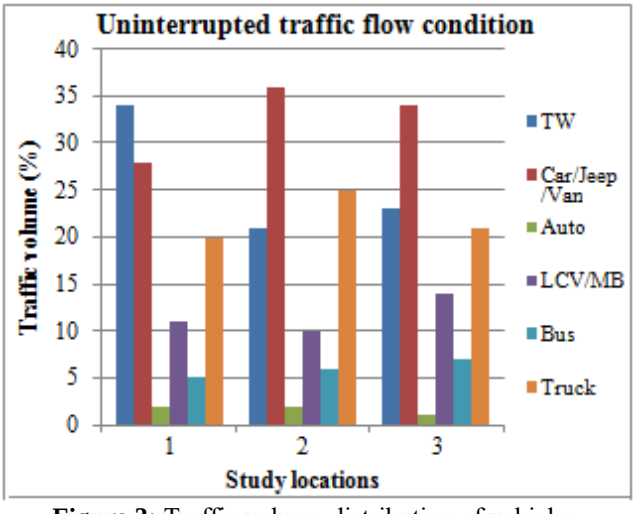

Figure 3: Traffic volume distribution of vehicles

The variation in mean traffic noise levels at each study location of uninterrupted traffic flow is shown in Figure 4.From the figure it can be observed that the noise levels at the study locations varied from 72.4 – 77.5 dB (A). These variations from location to location are mainly due to the difference in type of zone, prevailing traffic volume, speed, background noise, meteorological parameters. However these values are within the ambient noise standard of CPCB (Central Pollution Control Board), New Delhi, India.

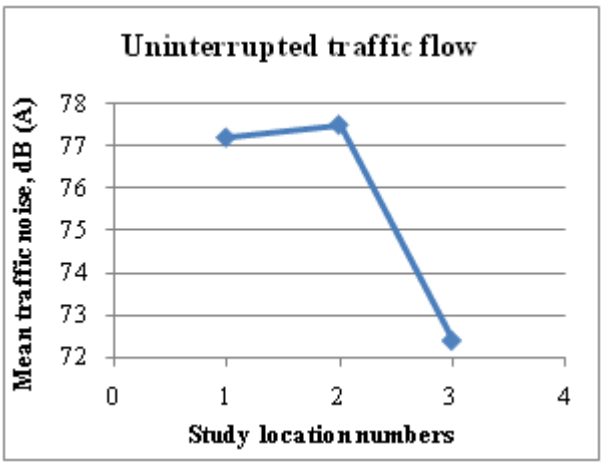

Figure 4: Traffic noise level at uninterrupted location

In order to know the influence of traffic noise level on traffic volume, all vehicles were converted into equivalent volume based on acoustic equivalence. The calculated equivalent traffic volume at the study locations of uninterrupted traffic flow is shown in Table 4. The variation of mean traffic volume and mean traffic noise at each study location is shown in Figure 5.It can be observed from Figure, that the traffic volume is varying from location to location and it bearing significant influence on traffic noise levels. The traffic volume at each study location is synchronous with traffic noise levels. However, the slight variation is mainly due to the type of vehicles moving in the traffic stream, traffic volume and speed and prevailing environmental conditions.

Table 3: Equivalent Volume and Speed For Uninterrupted Traffic Flow

Location Number	Equivalent volume (Q_E)	Equivalent speed (S_E)	Log (Q_E)
1	4148.8	51.13	3.6
2	3547.09	44.84	3.55
3	3024.93	46.16	3.48

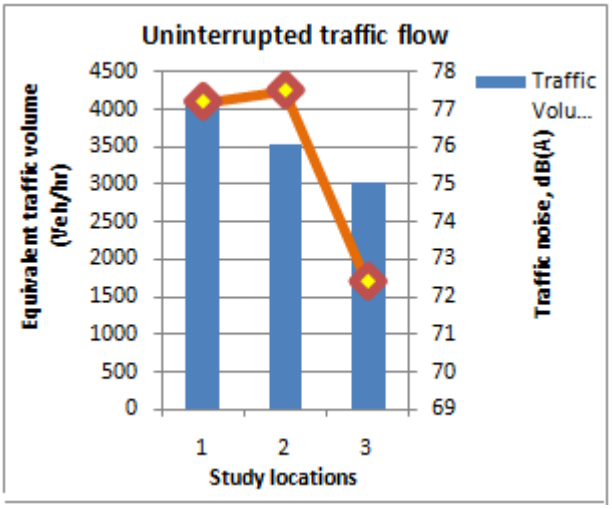

Figure 5: Variation of mean traffic noise and mean traffic volume in uninterrupted traffic flow

Analysis of Traffic Noise, Traffic Volume and Speed at Interrupted Flow Conditions

Traffic noise was recorded for varying traffic situations at each of interrupted traffic flow location along with other required traffic data. The percentage distribution of different types of vehicles at the study locations of interrupted traffic flow is given in Table 4 and Fig 6. It can be observed from the tables that percentage distribution of different category of vehicles at the study locations varied from 45-50% for Two Wheelers, 1-2% for Auto, 27-33% for Car/Bus/Van, 4-5% for Bus, 5-7% for LCV/MB, 8-12% for Trucks.

Table 4: Percentage Distribution of Classified Vehicles under Interrupted Traffic Flow Condition

Study location	Percentage distribution of classified vehicles					
	TW	Car/Jeep/ Van	Auto	LCV/MB	Bus	Truck
4	45	33	2	5	5	10
5	48	31	1	7	5	8
6	50	27	2	5	4	12

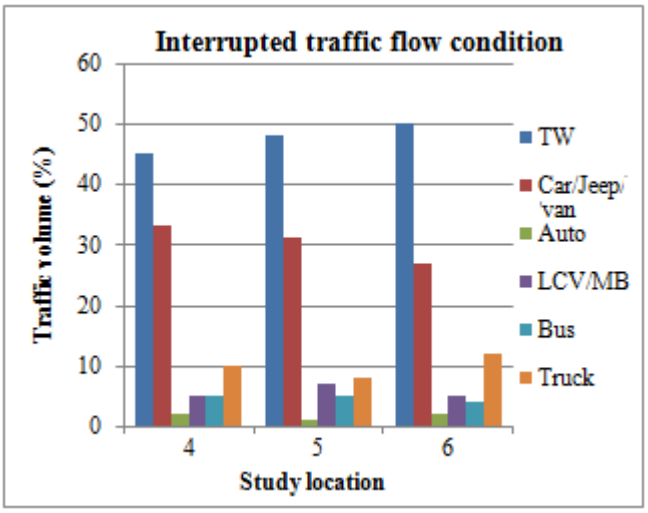

Figure 6: Variation of mean traffic noise and mean traffic volume in interrupted traffic flow

Traffic noise was observed for varying traffic situations along with essential traffic data. The mean of those observed values at each of the interrupted traffic flow locations are depicted in Figure 6. It can be seen that the mean traffic noise level at study locations of interrupted traffic flow varied from 78.2 – 80.6 dB (A).These values are within the ambient noise standard of CPCB (Central Pollution Control Board), New Delhi, India, prescribed for different zones.

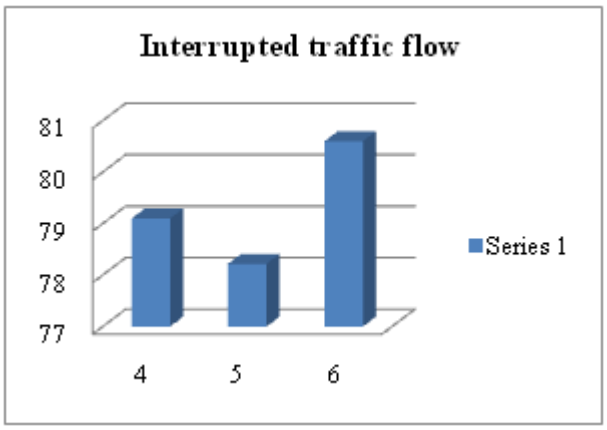

Figure 7: Traffic noise level at interrupted location

The calculated total equivalent traffic volume at each study location of interrupted traffic flow is shown in Table. The variation of observed mean traffic noise with respect to traffic volume from location to location is presented in Figure. The figure shows that the traffic volume and noise level are synchronous to each other. However, the slight variation is mainly due to the traffic signals and type of vehicle moving in traffic stream.

Table 4: Equivalent Volume and Speed under Interrupted Traffic Flow Conditions

Location number	Equivalent volume (Q_E)	Equivalent speed (S_E)	Log (Q_E)
4	3419.31	34.82	3.53
5	4575.35	22.19	3.66
6	3369.39	22.44	3.53

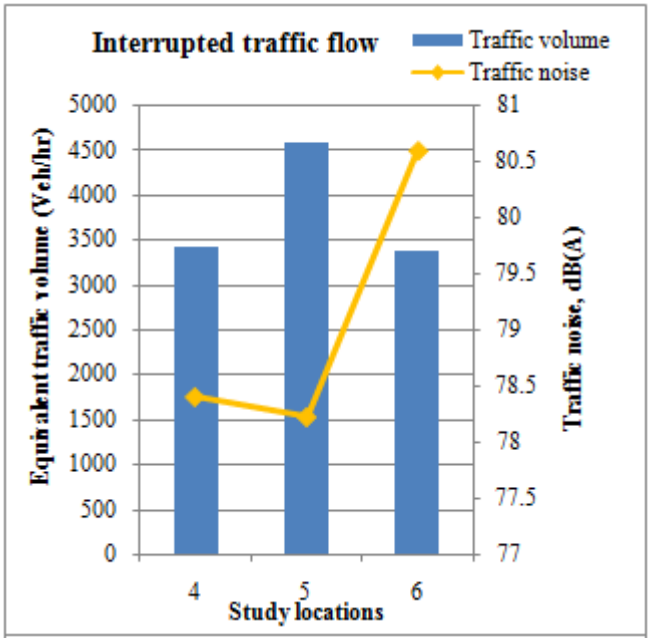

Figure 8: variation of mean traffic noise and mean traffic volume in interrupted traffic flow

Comparison of Traffic volume and Speed study with Noise under Interrupted and Uninterrupted traffic flow conditions

By comparing traffic volume and noise level under Interrupted and Uninterrupted traffic flow conditions, it was observed that Noise level is higher in Interrupted junctions to the Uninterrupted junctions and the result is shown in Figure 9(A)&(B).

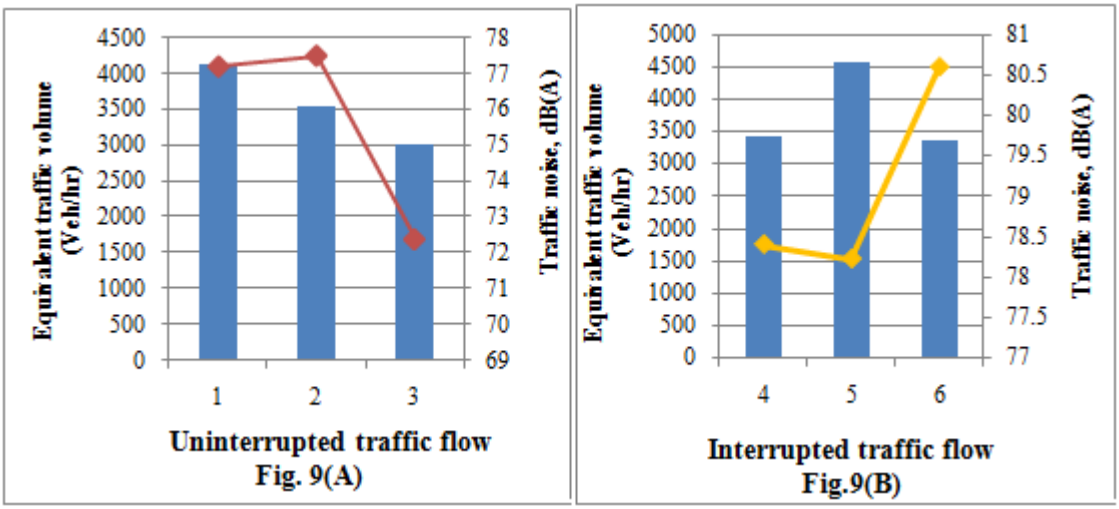

Figure 9: Comparison of traffic volume and noise level under uninterrupted and interrupted traffic flow condition

By comparing traffic speed and noise level under Interrupted and Uninterrupted traffic flow conditions, it was observed that Noise level is higher in Interrupted junctions to the Uninterrupted junctions. The result is shown in Figure 10(A) & 10(B).

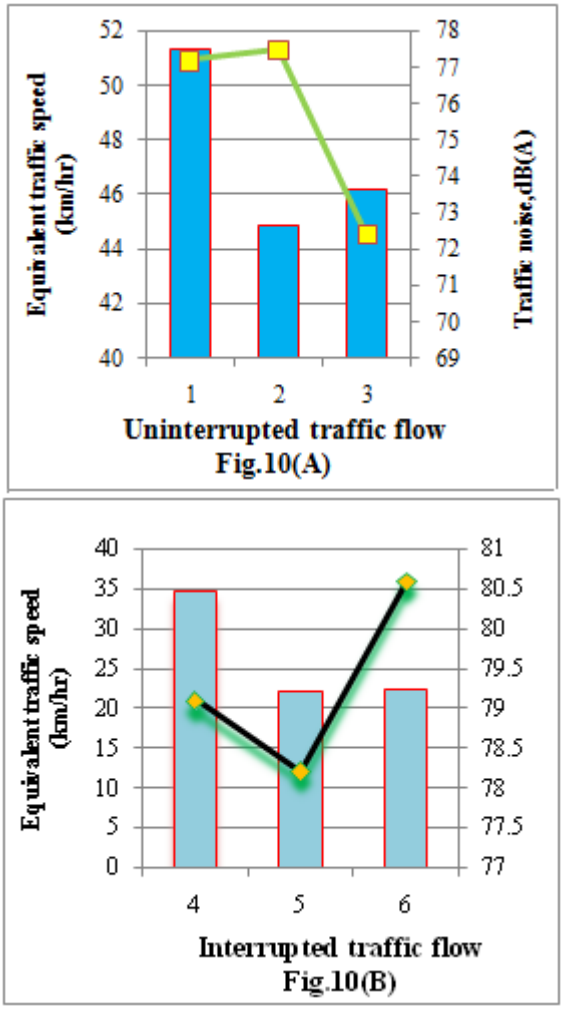

Figure 10: Comparison of traffic speed with noise level under uninterrupted and interrupted traffic flow conditions

5. Conclusion

From the analysis it is concluded that measured noise level was within the permissible limits at both Interrupted and Uninterrupted traffic flow conditions. From equivalent traffic volume study with noise level, the amount of noise measured is higher in interrupted locations when compared with the uninterrupted locations. From equivalent traffic speed study with noise level, the amount of noise measure is higher in interrupted locations when compared with the uninterrupted locations

References

[1] Banerjee D.S, Chakraborty K, Bhattacharyya S, And Gangopadhyay A, (2009). "Appraisal and mapping the spatial-temporal distribution of urban road traffic noise". Int. J. Environ. Sci. Tech., 6(2): 325-335.

[2] Benedetto, G., Spagnolo, R.. (1977): "Traffic noise survey of Turin, Italy", applied acoustics, vol. 10 (3), pp 201-222.

[3] BhavenTandel, Dr. Joel Macwan, Pratik , Ruparel.N , (2011), "Urban corridor noise pollution: A case study of Surat city, India", International Conference on Environment and Industrial Innovation, vol 12, pp 144-148.

[4] Campbell Steele, (2001), "A critical review of some traffic noise prediction models", Applied Acoustics vol 62, pp 271-287.

[5] Deb Dulal Tripura and ParthaPratimSarkar, (2011), "Traffic Noise Prediction Model in Agartala City, India", International Review of Applied Engineering Research, vol 1(1), pp 93-98.

[6] EPA, November (2006): "Measurement of noise level at different locations of Rawalpindi and Islamabad", Pakistan Environment Programme, EPA.

[7] G. Cammarat, S.Cavalieri, (1993), "Noise prediction in urban traffic by a neural approach", International Workshop on Artificial Neural Networks, Sitges, Barcellona, Spain.

[8] Guoxia Ma, YujunTian, Tianzhenju and ZhengwuRen, (2006), "Assessment of traffic noise pollution from 1989 to 2003 in lanzhou city", Environmental Monitoring and Assessment, Springer.

[9] GoswamiSh, "Road Traffic Noise: A case study of Balasore town, Orissa, India", International Journal of Environmental Research, vol 3(2), pp 309-316.

[10] Golmohammadi R., Abbaspour.M, Nassiri.P, Mahjub.H, (2007), "Road Traffic Noise Model", Journal of Research and Health Science, vol 7(1), pp 13-17.

[11] Jamrah A, Al-Omari A, and Sharabi R, (2006)."Evaluation of traffic noise pollution in Amman, Jordan". Environ. Monitor. Assess., 120: 499–525.

[12] Jain S.S, Parida M, and Bhattacharya C.C, (2001), "Development of Comprehensive Highway Noise Model for Indian conditions". Journal of Indian Road Congress, 62-3, PP.453 A-488 A

[13] KrishnaMurthy.V, AhamadKamruzzamanMajunder, Sanjay NathKhanal, Deepak Prasad Subedi, (2007), "Assesment of Traffic noise Pollution in Badepa, a Semi urban town of Nepal", Kathmandu University Joural of Science, Engineering and Technology, volume (No IV), pp1-9.